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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVII.—No. 415.

THE ELECTRICAL TRANSMISSION OF POWER.

IT is scarcely to be expected that the recent experiments of M. Marcel Deprez which are fully dealt with in our other columns, will excite the same amount of interest, we might almost say sensation, as the results of his previous experiences between Miesback and Munich, Vizille and Grenoble, and other places, notwithstanding the fact that they are of a more grotesque and fantastic character. We are now so conversant with matters involving the transmission of power by electricity, that the results obtained through the dogged determination of the French electrican to overcome the many obstacles with which his path has been beset, will fail to arouse any degree of enthusiasm, at least on this side of the Channel. What with the Portrush tramway, a similar line between Bessbrook and Newry, the telpher system at Glynde, &c., the public has long been convinced that the electrical transmission of power could be readily and successfully undertaken. We do not, of course, intend to lead our readers to think that the operations carried out in this country can compare in magnitude or distance traversed with those of M. Deprez, but we do mean that had any of our electrical engineers received such support and assistance as has been accorded to him the same thing could as readily have been accomplished in England in much less time, and, we think, in a manner less open to criticism. We notice that M. Deprez still adopts the plan of putting his apparatus in a looped circuit, and this in itself is enough to make one doubt the accuracy of his tests, unless the line were perfectly insulated, which we need not say could not have been the case. To have obtained the results with which the French engineer credits himself, his generator must have been capable of reproducing nearly 80 per cent. in the external circuit of the mechanical power exerted in driving it, and the recipient must have converted nearly 80 per cent. of the electrical energy received into available power. We have not had M. Deprez's figures before us sufficiently long to enter deeply into the matter here, but in a future issue we shall take occasion to go more fully into an impartial examination of his tabulated results. The idea, however, of separately exciting the field-magnets of the motor is an absurdity upon which we need not enlarge, for in practice the motor must decidedly be self-acting in this respect.

We may in conclusion state that, so far as we can judge at the present moment, M. Deprez's figures will not bear a careful analysis.

ELECTRIC LOCOMOTION.

By A. RECKENZAUN.

I.

IN turning our mind towards that period when electric lighting began to be the all absorbing theme, when the public at large was startled by the wonderful doings at the other side of the Atlantic, when gas shareholders trembled and electric light shareholders rejoiced, we are tempted to ask ourselves why the subject of electric locomotion was all but forgotten in the midst of this excitement. Although many of the newly born limited companies assumed the title of Light and *Power* Company, several managed to spend their money in putting up unsuccessful electric light installations, whilst few of those who professed to be suppliers of "motive power" ever thought of enquiring into the merits of this subject.

It cannot be said that the field was an unknown one, for the application of electricity as a motive power engaged the attention of ingenious minds long before the incandescent lamp was invented. Salvatore Dal Negro published an account of his experiments with an electro-magnetic machine in the year 1832; Professor Jacobi gave a description of his first motor in 1834 before the Academie des Sciences in Paris, and he constructed and worked an electric boat in the year 1839. These experiments were carried out on a large scale, regardless of cost, at the expense of the Emperor Nicholas. Robert Davidson placed an "electro magnetic" locomotive on the Edinburgh and Glasgow Railway in 1837: the carriage was 16 feet long, 6 feet broad, it weighed 5 tons, and ran at a speed of 4 miles per hour. Numerous other attempts were made, and had to be abandoned, mainly on account of the great cost of the battery power. Dynamo machines were unknown. Electric lighting has received an extraordinarily rapid development with the introduction of the dynamo-electric machine, but this development could not have been so rapid had it not been for the liberal amount of financial support it received. Whatever company promoters and speculators may have made out of the electric lighting scare, there is no doubt that immense sums were spent on experiments and improvements upon apparatus which were no sooner patented than sold at enormous prices. There were many failures in spite of lavish expenditure of money and brain power—they will soon be forgotten; but the fact remains, that electric lighting, from a technical point of view, would not have reached its present state of perfection without that universal support and that large number of intelligent men who helped in perfecting so many details. The very rapidity of progress appeared to justify us in the belief that apart from the superior quality of the electric light, it would soon be made cheaper than any other illuminant, and, as light is the more universal commodity, this step-sister, "motive power," has been left with a comparatively poor dowry.

Much has been said and written about the vast amount of energy in nature which runs to waste and which *could* be stored, or transmitted electrically to great distances; but in these times of depression in the various manufactures, we are more than fully supplied with motive power; moreover, when we come to examine carefully into the prime cost of a water power installation, and the cost of conductors requisite for carrying the electric energy to the factory, which for obvious reasons cannot be erected near the waterfall, we find that the advantages which we expected to derive through this new medium of transmission are not very great. Nevertheless, there are many instances where electricity could be advantageously employed, and especially for the purposes of locomotion. In countries where water power is plentiful, and coals or other fuel expensive, there we may transmit the electric energy to a distance which is determined by the price of the available fuel, and in most countries where horses are dear, and coals or water power comparatively cheap, there electric locomotion will find a profitable field; we refer to tramways and light railways. There are many instances where neither horses nor steam engines can be advantageously used, as in underground locomotion, across fields and mountains without proper roads; in the latter case, the new system of electric locomotion, telpherage, will come largely into use. Lastly, electricity as a motive power, will and does find applications in boats for pleasure, and war purposes, not forgetting its services for experiments with navigable balloons.

Our aim in the following series of articles will be to explain: Firstly, the best known means of producing the electric energy and converting it into mechanical power; Secondly, to show how the efficiency of any system may be tested, giving numerical examples of existing applications; and Thirdly, the prime cost, maintenance and depreciation, as far as it is in our power to ascertain the same.

Without attempting to wade through the historical part of our subject, it may be interesting to quote a passage or two from a paper "On Electro Magnetism as a Motive Power," by Robert Hunt, read at the Institution of Civil Engineers, in April, 1857, because in that paper, the author draws comparisons between the amount of energy given out by a pound of zinc in a battery, and that of a pound of coal in a steam boiler, and as there are people who, at the present day, endeavour (knowingly or unknowingly) to persuade laymen of the wonderful things obtained by means of primary batteries, this digression may be pardoned. There we read: "Mechanical force whether obtained in the form of man power, horse power, steam power, or electrical power, is the result of a change of form in matter. In the animal, it is the result of muscular and nervous energy, which is maintained by the due supply of food to the stomach. In the steam engine, it is the result of vapour pressure, which is kept up by the constant addition of fuel to the fires under the boilers. In the magnetic engine, it is the result of currents circulating through wires, and these currents are directly dependent upon the chemical change of zinc, or of some other metal in the battery. Then,

"Animal power depends on food.
"Steam power depends on coal.
"Electrical power depends on zinc.

"The heat evolved by the combustion of one pound of coal is equivalent to the mechanical force capable of raising 9,584,206 lbs. to the height of one foot, or to about ten times the duty of the best Cornish engines. Joule gives as the results of his experiments the mechanical force of the current produced in a Daniells battery as equal to 1,106,160 lbs. raised one foot high per pound of zinc, and that produced in a Grove's battery as equal to 1,843,600 lbs. raised one foot high per pound of zinc. This is infinitely above what can be practically obtained. Upon the whole, we feel ourselves justified in fixing the maximum available duty of an electro-magnetic engine worked by a Daniells battery at 80 lbs., raised a foot high for each grain of zinc consumed. This is about one-half of the theoretical maximum duty. In the Cornish engines, doing the best duty, one grain of coal raised 143 lbs. one foot high. The price of zinc is £35 per ton, and that of coal £1 per ton. By improving the battery arrangements, operators may eventually succeed in getting a greater available electric force. But it must not be forgotten that the development of any physical force observes a constant law. Whether in burning coal in the furnace, or zinc or iron in the battery, the chemical equivalent represents the theoretical power. Zinc burns at an elevated temperature; in burning a pound of zinc there should be obtained as heat the same amount of mechanical power which is obtained as electricity in the battery. The heat being more easily applied as a prime mover, it would be far more economical to burn zinc under a boiler, and to use it for generating steam power, than to consume zinc in a voltaic battery for generating electro-magnetic power."

The phraseology is not one which we should accept with our present knowledge and modern definitions, but the figures given serve the purpose of the quotation.

EXPERIMENTS WITH THE THERMAL TELEPHONE.

By CHAS. R. CROSS.

IN the TELEGRAPHIC JOURNAL for 1880, p. 204, Mr. Wm. H. Preece describes some very interesting experiments with a new form of telephonic receiver, consisting of a fine stretched wire, one end of which is attached to the middle of a diaphragm and the other to an adjustable support. The wire is placed in circuit with a voltaic battery and a microphone. When the microphone is actuated by the voice the electrical undulations thereby produced in the battery circuit cause corresponding variations in the temperature, and hence in the tension of the wire, and thus the diaphragm is set into vibration so that speech is reproduced.

Mr. Preece used six "bichromate of potash" cells. He does not state the amount of the heating effect on the wire, but from what is said it is evident that the temperature of the wire was but slightly elevated.

The statement of results in the paper referred to is quite brief, and the experiments detailed below were undertaken in order to ascertain to what extent speech can be reproduced by such a receiver, both as to loudness and intensity; to study somewhat further the changes due to variations in the length and diameter of wire of different materials, under varying conditions of current strength; and, especially, to observe the effect of varying the temperature of the wire. Most of the experimental work has been carried on under my direction by Messrs. W. J. Hopkins and J. O. Ellinger, students in the laboratory of the Mass. Institute of Technology.

We first sought to find under what conditions we could realise the maximum loudness of speech, using platinum wire, which had given the best results with Mr. Preece. For a transmitter we used a Hunning microphone, a form of transmitter in which granulated carbon is employed, the powder being loosely confined between two metallic plates. The battery used consisted of from 1 to 12 Grenet cells, the maximum current used being sufficient to raise the temperature of a platinum wire ·01 inch in diameter, and about 10 inches long to redness. In order to avoid excessive heating of the transmitter it was placed in derived circuit with the battery and receiver. In some experiments the diaphragm was made of firm cardboard, and in others of sheet iron.

One would naturally suppose that the larger the wire the greater would be the variations in tension, and hence the greater the loudness of the resulting sound. If, however, the length of the wire is increased beyond a certain limit the quality of the articulation appears to become very inferior, even though the loudness may be somewhat increased; and the wire tends to assume a free vibration of its own, producing a confusing after-tone.

The heaviest wire that we used was 0·0095 inch in diameter, as want of the requisite current at the time of the experiments prevented our increasing the diameter beyond this. With it a length of about six inches gave in general the maximum loudness, as Mr. Preece had previously observed.

Using a platinum wire ·004 inch in diameter and from 6 to 7 inches long, with sufficient current to raise its temperature to dull redness, very remarkable results were obtained. Not only could the most unfamiliar conversation be understood, but words spoken into the transmitter were heard and understood with the ear at a distance of from 2 to 10 inches from the diaphragm of the receiver, the character and loudness of the sound being very similar to that obtained when a Hunning transmitter is used with an ordinary magneto receiver. Using a somewhat shorter wire at the same temperature gave a decidedly better quality of sound, but the loudness was very materially dimin-

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* Read at a meeting of the American Academy of Arts and Sciences, October 14th, 1885.

ished. Lowering the temperature caused a rapid diminution in the loudness of the sound.

Almost as good results were obtained with German silver wire, a material not mentioned by Mr. Preece; but with this the influence of temperature was far less marked than in the case of platinum. In fact, quite as good results both as to loudness and distinctness of articulation were obtained when the wire was simply warm to the touch as when it was hotter. In this respect, German silver differs from any of the other materials that we used. With iron and copper but few experiments were tried, and the results were quite unsatisfactory.

It is difficult to give any numerical estimate of loudness and distinctness in such experiments as these. The following tables, however, besides furnishing a more precise idea of our results will show the result reached in some attempt to form a numerical estimate of the relative intensity under different circumstances. The loudness of an ordinary magneto receiver when used with a magneto transmitter, spoken into with a moderately loud tone of voice is called 10.

German Silver wire, Diameter 0·007 in., just below Redness.

Length.	Nature of Articulation.	Comparative Loudness.
10 1-2 in.	Faint, but distinct	3
7 1-2 „	Clearer	7
5 „	Same as in last experiment	8
3 „	Poor and indistinct	4

Platinum Wire, Diameter ·0095 in., at Red Heat.

10 1-2 in.	No sound	0
7 1-2 „	Very faint	1
5 „	Quite distinct speech	4
3 1-2 „	No sound	0

Platinum Wire, Diameter ·006 in., just below Redness.

10 1-2 in.	Distinct	Fairly loud
7 1-2 „	No change in distinctness	Loud as magneto
6 1-2 „	„ „	Louder
4 1-2 „	„ „	Much fainter
2 1-2 „	Very indistinct	Barely audible

Note.—In the last experiment the wire was cool when the shorter length was used.

Platinum Wire, Diameter ·005 in., just below Redness.

7 in.	Speech easily understood	Moderately loud
5 „	Clearer	„ „
3 „	Fairly distinct	Fainter

Platinum Wire, Diameter ·004 in., just below Redness.

10 3-4 in.	Speech fairly distinct	Faint
7 1-2 „	Very distinct	Much louder
3 1-2 „	Clear	Less loud
2 1-2 „	„	„ „
1 1-4 „	No sound	Inaudible

Platinum Wire, Diameter ·002 in., just below Redness.

5 in.	Fairly distinct	5.
3 „	Less distinct	9·
1 3-4 „	No sound	0·1

From these and other experiments, it appears that our best results were obtained with the wire ·006 in. and ·004 in. in diameter, there being but little difference between them. The largest wire used (·0095 in. diameter) gave very poor results, and with the battery power used by us the finest wire employed (·002 in. in diameter), was equally inefficient. Mr. Preece's best results were secured with platinum wire ·001 in. in diameter; also, with the finer wire, the most effective length was less than with the larger sizes. The most interesting point, however, developed in the course of our experiments is the effect of increasing the temperature, notably with platinum wire, in increasing the loudness of articulation of the thermal receiver. This will naturally be attributed to the greater expansibility of the wire at high temperatures. It is possible that with German silver the effect, good at moderate temperatures, is not bettered on heating the wire, because of a marked influence of temperature in diminishing its elasticity.

The question also suggested itself as to what effect, if any, would be produced if the microphone were placed in the primary circuit of an induction coil, and the wire receiver in the secondary circuit, so that the receiver would only be acted upon by the induced currents from the coil. Since the heating effect varies as the square of the current with such an arrangement, difference of sign in the current could not be perceived at the receiver, and therefore one would not expect to be able to distinguish articulate speech. We thought that if any sound was produced it would be interesting to study its quality as compared with the quality of the sound actuating the transmitter. Our results, however, were negative. A sound was produced on breaking the circuit, but no audible effect was observed on speaking or shouting into the transmitter. In these experiments German silver wire was used in the hope that even at ordinary temperatures it might prove sensitive. Independent heating by a current of hot air was tried, but without success.

An attempt was also made to use the thermal telephone as a transmitter. Sir Wm. Thomson has shown in his researches on the electro-dynamic qualities of metals (Math. and Physical Papers, vol. ii., p. 208) that the electrical resistance of wires is varied by their tension, and, indeed, it was in following out this idea that Professor Hughes was led to his invention of the microphone (TELEGRAPHIC JOURNAL, May 15th, 1878).

Slight as the variation in resistance must necessarily be with such a transmitter, we yet hoped that the exceeding sensitiveness of the magneto receiver would suffice to detect it. Our results, while not at all striking, were sufficiently encouraging to lead us to hope for greater ultimate success. The thermal telephone, with a platinum wire 4 1-2 inches long and 0·004 in. in diameter, and an iron diaphragm was placed in circuit with a battery of 10 Grenet cells and an ordinary hand telephone receiver. The current was sufficient to heat the wire almost to redness. All the joints of the wire were soldered to prevent the possibility of microphonic action, which at first caused some annoyance, but which was readily recognisable by the scratching sound produced by it. With the joints thus soldered, and every precaution taken to avoid such microphonic disturbances, we succeeded in hearing and understanding at the receiver the word "hallo," and some brief familiar sentences. The sound was low but distinct and clear, and in quality quite unlike the sound produced by microphonic action. There seems to be no doubt that electrical undulations were produced in the circuit by variations in the stress to which the heated wire was subjected. Similar results were obtained with a smaller number of cells, even down to one, but the sound was then exceedingly faint and scarcely audible. Speech was also transmitted by a thermal transmitter in which German silver wire was substituted for the platinum. It may be that the more marked results on heating the wire to a higher temperature by the use of a stronger battery indicate that at such a temperature the electrical effect of changes in stress in varying the resistances of a wire is increased.

Note.—During the discussion that followed the reading of the foregoing paper, Professor A. E. Dolbear stated that he had experimented with the thermal telephone receiver as early as 1878, using a few gravity cells, and transmitting speech audibly, though very feebly.

The Society of Telegraph-Engineers and Electricians.—A meeting will be held at the Institution of Civil Engineers, 25, Great George Street, Westminster, S.W., on Thursday, November 12th, when Major-General Webber, C.B. (Ret.), R.E., Past President, will give a paper on "The Telegraphs of the Nile Expedition."

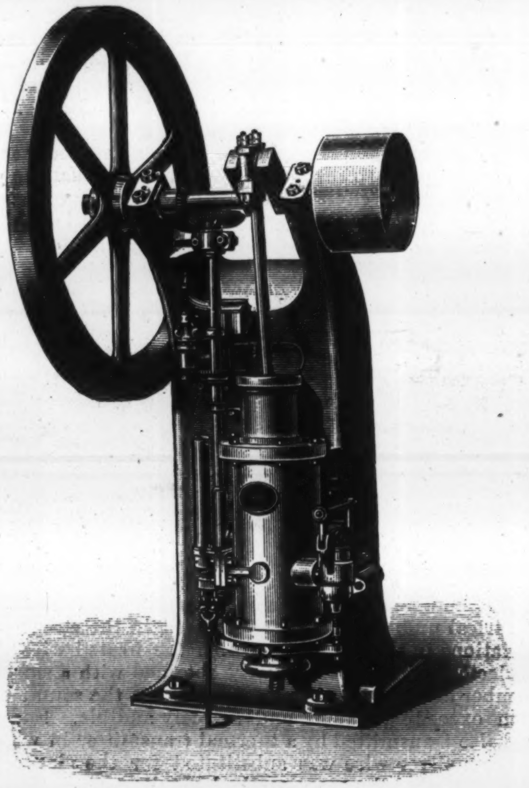
THE "GLASGOW" GAS ENGINE.

THE use of coal gas as a motive power is daily assuming greater importance, but it is not our intention to do more than make a passing reference to the principles upon which gas engines work; some reference, however, is necessary in order that our subsequent remarks may be understood.

Gas engines are of two classes; in the first a mixture of gas and atmospheric air is admitted to the cylinder and exploded at atmospheric pressure, the piston is forced forward by the explosion, and power is thus communicated to the crank shaft. The consumption of gas is great for the power developed, and hence this class of engines, except for very small sizes, has not met with much favour.

In the second class of engines the explosive mixture is fired under compression, and thus a greater power is obtained for a given quantity of gas than in engines where the explosion takes place without compression.

Among the first in this country to recognise the importance of the principle of compressing the charge of explosive mixture before firing, was Matthew Boulton, who took out a patent in the year 1866 and another in 1868, in which he describes how "the charge under the piston is compressed to such a degree as may be desired." He then goes on to describe how the gases after combustion are expelled by the back-stroke of the piston and the new charge drawn in by the return-stroke.



This principle, under various modifications, has been largely adopted by various makers.

In 1876, Charles D. Abel took out a patent for an engine in which atmospheric air is drawn in the cylinder during the first part of the out-stroke, and during the remainder of the stroke a mixture of air and gas; the in-stroke compresses the charge, which is fired under compression. Messrs. Crossley of Manchester acquired this patent and have worked it very successfully.

Hitherto, in gas engines made on the principle of compression, the cylinder at the out-stroke has been entirely filled by the charge; the proportions of gas and air may vary in different engines, but in all of them the cylinder at the out-stroke is filled with the explosive mixture at atmospheric pressure, while at the in-stroke the compression remains uniform.

Last year a patent was secured by John Magee for a gas engine embodying two important improvements. The explosive mixture is admitted to the cylinder through a revolving valve, but instead of filling the cylinder, the admission of the mixture is shut off before the out-stroke is completed, and thus the charge is expanded during the remainder of the out-stroke, and the heat generated by the previous explosion is taken up by the rarefied charge and utilised. The other improvement consists of a movable piston between the cylinder bottom and the working piston. A screw attached to the movable piston passes through the cylinder bottom, a hand-wheel on this screw enables the attendant to shift the piston out or in, thereby contracting or enlarging the chamber where the explosion takes place at pleasure. Before starting the engine a few turns of the wheel draws back the piston, leaving a considerable space between it and the working piston; this reduces the compression and renders the operation of starting the engine very easy. When the momentum of the fly-wheel is sufficient to overcome a higher compression, the hand-wheel is turned and thus with a diminished charge a high compression is secured, resulting in great economy of gas.

The Glasgow Gas Engine Company, Limited—formed to work this patent—showed two engines at the Mining Exhibition recently held in Glasgow. One of those engines was of 2 H.P. nominal, of the horizontal type; the other vertical and of the same power. We are enabled to give an illustration of the latter.

Both engines are very compact, and the results show that the principle of expansion combined with high compression—variable at pleasure—secures important advantages. As before explained, the system of expanding the charge before compression, absorbs and utilises the heat, which in other engines has to be counteracted by a cold water jacket on the cylinder and a large tank. In the engines exhibited by the Glasgow Gas Engine Company, scarcely any cooling arrangement is required. The system of working the revolving admission valve is also worthy of notice. The necessary contact between the valve and its seat is accomplished in a novel and ingenious manner. A small piston open to the chamber where the explosion takes place, is connected by a lever with the admission valve, so that the exact pressure due to the explosion is instantaneously communicated to the valve. The action is automatic and cannot fail to give the exact pressure on the valve to keep it perfectly tight, while during the remainder of the revolution the valve works free from pressure and with very little friction.

ON SOME PRACTICAL ELECTRICAL FORMULÆ.

(For Use in Constructing Circuits, Electro-magnet Coils and Dynamos.)

By F. V. ANDERSEN.

PART I.

On a Constant $\kappa = \textit{Resistance} \times \frac{\textit{section}}{\textit{length}}$.

SINCE the resistance of a conductor is proportional to the length, L, and inversely proportional to the cross-section, s, of the conductor, the resistance, R, is expressed by

$$R = \kappa \frac{L}{s}$$

where κ is a constant for a certain material at a certain temperature.

Let R be in ohms;
L „ feet;
s „ square inches,

then

$$13\cdot59 = \kappa \frac{5280}{\cdot003068} \quad \therefore \kappa = \frac{13\cdot59 \times \cdot003068}{5280} =$$

$$7\cdot897 \times 10^{-6}$$

for pure copper at 15·5° C. (60° F.)

(Dr. Matthiessen : 1 mile of pure copper wire $\frac{1}{16}$ inch diameter has $R = 13\cdot59$ ohms at 15·5° C.)

Further, since κ is proportional to the specific resistance multiplied into the coefficient for temperature, we shall have for different materials at different temperatures

$$\kappa\,\mu = \rho \times 7\cdot897\,[1 + (t - 15\cdot5)\,\tau]$$

where ρ = specific resistance (that of pure copper being = 1) ;
t = temperature of conductor in degrees Centigrade ;
τ = temperature coefficient (for copper = ·00388).

For iron wire we have ρ about = 6, so at 15·5° C.

$$\kappa_{\text{iron}} = 6 \times 7\cdot897 \times 1 = 47\cdot38 \times 10^{-6}.$$

For copper conductors of ordinary conductivity, 95 per cent., we get

Temperature in degrees Centigrade.	Value of κ.
15·5	$8\cdot31 \times 10^{-6}$
20·	$8\cdot46 \times 10^{-6}$
30·	$8\cdot79 \times 10^{-6}$
40·	$9\cdot11 \times 10^{-6}$
45·	$9\cdot28 \times 10^{-6}$
50·	$9\cdot44 \times 10^{-6}$
60·	$9\cdot77 \times 10^{-6}$

This table includes the range of temperature within which all ordinary circuits and dynamos are worked.

This formula

$$\text{Ohms} = \kappa \frac{L}{s}$$

will be found very convenient for many calculations. In the following lines I shall give you a series of examples.

A.—*Fall of Potential in Cables.*

ε = fall in volts ;
c = current in ampères ;
a = ampères per square inch in cable,

then :

$$\varepsilon = c \frac{\kappa L}{s} \qquad \text{I.}$$

but

$$c = a\,s$$

and so

$$\varepsilon = a\,\kappa\,L \qquad \text{II.}$$

In an electric light installation the leads are as a rule taken so that when the full work is on, a has approximately the same value through the whole system ; we then have $a\,\kappa$ known ; very often $a = 1000$; if the working temperature is taken as 20° C., this figure becomes $1000 \times 8\cdot46 \times 10^{-6} = \cdot00846$, and the number of volts lost in the wires to a certain lamp is ascertained by multiplying this figure into the length of leads in feet to the same lamp.

Let the greatest distance from the generator terminals to a lamp in an installation, where $a = 1000$, be 200 feet, then the greatest loss of potential in this installation is

$$\varepsilon = \cdot00846 \times 200 \times 2 = 3\cdot38 \text{ volts.}$$

B.—*Efficiency of cables* through which is transmitted energy at a given current and potential.

E = total electromotive force from generator ;
e = useful electromotive force received through cables.

$$\text{Efficiency, } \eta = \frac{e}{E} = \frac{e}{e + \varepsilon} = \frac{E - \varepsilon}{E}$$

$$\varepsilon = a\,\kappa\,L \qquad \text{(I)}$$

so

$$\eta = \frac{e}{e + a\,\kappa\,L} = 1 - \frac{a\,\kappa\,L}{E} \qquad \text{III.}$$

EXAMPLE : 50 ampères transmitted through a line half a mile long (length of cable 1 mile), cable conductor consisting of 7 wires No. 12, section = ·0594 ▭ inches. The electromotive force from generator being 250 volts, we have

$$a = \frac{50}{\cdot0594} = 842$$

$$\varepsilon = 842 \times 8\cdot46 \times 10^{-6} \times 5280 = 37\cdot6 \text{ volts.}$$

$$\eta = 1 - \frac{37\cdot6}{250} = \cdot85 \text{ or } 85 \text{ per cent.}$$

C.—*The potential which gives a certain efficiency* in transmitting energy at a given rate through a given line.

$$w = \text{the rate in watts.}$$

Then

$$c = \frac{w}{E} \text{ and } a = \frac{w}{s\,E}$$

insert this expression for a in formula III., we get

$$\eta = 1 - \frac{w\,\kappa\,L}{s\,E^2} \quad \therefore 1 - \eta = \frac{w\,\kappa\,L}{s\,E^2}$$

and

$$E = \sqrt{\frac{w\,\kappa\,L}{s\,(1 - \eta)}} \qquad \text{IV.}$$

EXAMPLE *a* : Transmit through the line described under B, 80 per cent. of 30,000 watts, what must be the electromotive force of the generator ?

$$E = \sqrt{\frac{30000 \times 8\cdot46 \times 10^{-6} \times 5280}{\cdot0594\,(1 - \cdot8)}} = \sqrt{\frac{3 \times \cdot846 \times 528}{\cdot0594 \times \cdot2}}$$

$$\log. E = \tfrac{1}{2}\,(\log. 3 + \log. \cdot846 + \log. 528 - (\log. \cdot0594 + \log. 2)) = \cdot52615 + 2$$

and

$$E = 336 \text{ volts.}$$

EXAMPLE *b* : What should be the electromotive force E_0 to give the same result if the conductor instead of being of copper had been of iron of same cross section ?

$$\kappa_{\text{iron}} = 6 \times \kappa$$

therefore

$$E_0 = \sqrt{6} \times E = 823 \text{ volts.}$$

D.—*The section of conductor* (copper) which will carry with a given efficiency a given number of ampères and volts to a given distance.

From III. :

$$\eta = 1 - \frac{a\,\kappa\,L}{E}$$

$$a = \frac{c}{s}$$

$$\therefore \eta = 1 - \frac{c\,\kappa\,L}{s\,E}$$

from which

$$s = \frac{c\,\kappa\,L}{E\,(1 - \eta)} \qquad \text{V.}$$

EXAMPLE : Suppose in the example used under C the electromotive force had been given = 336 volts and not the section. The current will be $\frac{30000}{336} = 89\cdot3$ ampères, then

$$s = \frac{89\cdot3 \times 8\cdot46 \times 10^{-6} \times 5280}{336\,(1 - \cdot8)} = \cdot0594.$$

E.—*The diameter of the wire* which, when filling up a coil of a known volume, will have a given resistance.

R = resistance of coil in ohms ;
v = total coil-space in cubic inches ;
v_1 = space actually taken up by the wire ;
d = diameter copper of wire in inches ;
δ = radial thickness of insulating cover, inches ;
D = diameter of wire covered = $(d + 2\,\delta)$, inches ;
l = mean length of one turn in feet ;

L = total length of wire in feet;
Δ = radial depth of coil;
λ = length of coil in inches.

We then have:—

$$\text{number of turns in each layer} = \frac{\lambda}{D};$$

$$\text{number of layers in coil} = \frac{\Delta}{D};$$

$$\text{number of turns in coil} = \frac{\Delta\,\lambda}{D^2};$$

$$\text{section of wire} = D^2\,\frac{\pi}{4};$$

from which

$$v_1 = \Delta\,\lambda\,\frac{\pi}{4} \times l,$$

now

$$v = \Delta\,\lambda \times l,$$

$$\therefore \frac{v_1}{v} = \frac{\pi}{4}$$

and

$$v_1 = \frac{\pi}{4}\,v.$$

We have, also:

$$v_1 = 12\,L\,D^2\,\frac{\pi}{4} = \frac{\pi}{4}\,v,$$

from which

$$L = \frac{v}{12\,D^2} \qquad \text{VI.}$$

Further

$$R = \frac{\kappa\,L}{d^2\,\frac{\pi}{4}},$$

and inserting above value for L,

$$R = \frac{\kappa\,v}{12\,D^2\,d^2\,\frac{\pi}{4}} = \frac{\kappa}{3\,\pi} \times \frac{v}{D^2\,d^2}$$

where $\frac{\kappa}{3\,\pi}$ is a constant under the conditions mentioned above, call it K.

For 95 per cent copper at 15·5° C.,

$$K = \frac{8{\cdot}31 \times 10^{-6}}{3\,\pi} = {\cdot}882 \times 10^{-6}.$$

$$R = K\,\frac{v}{D^2\,d^2}\ \left(\text{where } K = \frac{\kappa}{3\,\pi}\right) \qquad \text{VII.}$$

and since

$$D^2 = (d + 2\,\delta)^2,$$

so

$$(d + 2\,\delta)\,d = \sqrt{\frac{K\,v}{R}}$$

$$\therefore d^2 + 2\,\delta\,d - \sqrt{\frac{K\,v}{R}} = 0,$$

and

$$d = -\,\delta + \sqrt{\sqrt{\frac{K\,v}{R}} + \delta^2}. \qquad \text{VIII.}$$

Remark 1.—The number of layers which will go into a coil, using sizes of wire, such as No. 12 to No. 22, will be found somewhat like 10 per cent. higher than $\frac{\Delta}{D}$ because each layer sinks slightly into the preceding one; in fact, the number of layers with such wires, called n, we get

$$n = 1 + \frac{\Delta - D}{{\cdot}9\,D}.$$

[If all layers were wound in the same direction, going all from left to right, as they would be if wound for parallel arc, then we should have

$$n = 1 + \frac{\Delta - D}{\cos.\,30\,D} = 1 + \frac{\Delta - D}{{\cdot}866\,D}\ ]$$

Now this tends to make v_1 higher than $\frac{\pi}{4}\,v$, and again to increase the value of K. But this increase is balanced by the fact that in practice the number of turns in a layer does not reach the value $\frac{\lambda}{D}$, which requires every turn to lie absolutely tight against its neighbours in the same layer. We can, therefore, without any appreciable error, put as above the total number of turns in the coil $= \frac{\Delta\,\lambda}{D^2}$, which gives

$$v_1 = \frac{\pi}{4}\,v.$$

2.—For large coils carefully wound, *i.e.*, economising with the space, $K = {\cdot}88 \times 10^{-6}$ will be found very near correct by ordinary commercial copper at normal temperature.

(*To be continued.*)

PROCOPIUS DIWISCH.

A contribution to the history of electricity gathered from manuscript sources.

LIKE as at the present time men of culture interest themselves in the action and the application of the galvanic current, so a century-and-a-half ago an equally great enthusiasm for the study of frictional electricity obtained. Philosophers and amateurs attempted by numerous experiments either to call forth new phenomena or to search into their nature.

One of the most ingenious of those observers was Procopius Diwisch. He was born on the 1st of August, 1696, at Senftenberg, in Bohemia. He was educated at the Gymnasium at Znaim, and at the school attached to the Premonstrant Monastery at Bruck. After having finished his studies, he entered that monastery. Ordained priest, he taught natural philosophy in the year 1727. He knew how to render his lectures attractive by numerous interesting experiments. In the year 1733 he became Doctor of Theology and of Philosophy, and in 1737 he was appointed pastor of Prenditz, a small place in Moravia. As the cure of souls left him much leisure he continued his philosophical researches; they were, however, interrupted, as he had to officiate as prior of the monastery during the first and the second Silesian war. But in 1745 he returned to his cure, and gave up all his spare time to the study of natural philosophy. Although he studied hydrodynamics, acoustics and chemistry, it was principally his electrical experimenting that spread his fame.

In 1750 he was summoned to the Imperial Court at Vienna, where he made his experiments in the presence of the Emperor Francis and the Empress Maria Theresia; their Majesties were so delighted with those experiments that they presented him with their effigies imprinted on gold medals.

As he had already discovered the effect of points in drawing electricity from charged conductors, and being convinced of the identity of the lightning flash with the spark of the electrical machine, he constructed a lightning conductor (fig. 1), which he erected in his garden on the 15th of June, 1754. The apparatus consisted of a balk 22 fathoms high, which carried an iron rod surmounted by a cross, on whose arms twelve sheet-iron boxes were fixed. Each box was filled with iron filings, and closed by a lid of boxwood. Through that lid, and reaching to the bottom of the box, passed twenty-seven small iron bars, which were pointed like a lancet. The cross communicated with the earth by means of a chain consisting of thick iron rings, one end of that chain being fixed to the iron rod and the other end being buried two feet deep in the earth.

To Diwisch, therefore, belongs the honour of the priority of the invention of the lightning conductor; for he had already imagined and erected his conductor at a period when Franklin was still engaged in investigating whether the electricity of the clouds was identical with that of the electrical machine.

But, alas, he found no willing supporters like Franklin did.

In order to make his invention known to the world, he addressed himself to his patron, the Emperor Francis, who submitted the invention of the philosopher to the *savants* of his court, with the result that, as the latter did not recognise the usefulness of Diwisch's apparatus, it was rejected.

He even, as he himself wrote, encountered a great deal of animosity; and those who envied him, succeeded in inducing the peasants in the neighbourhood to destroy the conductor, after it had been six years in existence, as they alleged that it was the cause of the summer being so dry.

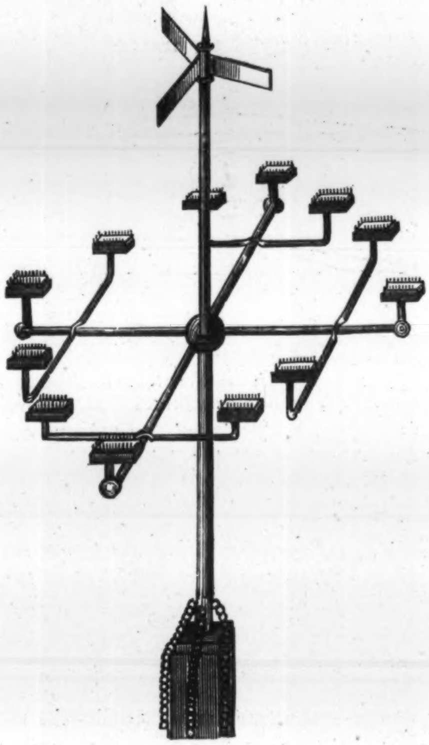


FIG. 1.

Diwisch was also the first who observed the beneficial influence of the electricity on the growth of plants; in his theoretical treatise on Electricity, he wrote as follows:—"Take two glass vessels, A and B, filled with the same sort of earth, and throw into those glasses a few lentil or lettuce seeds; if now A, but not B, be electrified for the space of two days, the seeds contained in the former will come up much sooner than those contained in the latter, and grow more if the electrification is continued. But if I want the vegetation in B to overtake that in A, I have only to expose the former for a few days to the influence of the electricity, whilst withdrawing the latter from that influence; the vegetation in B will, in that case, not only overtake but very soon surpass that in A."

He was also the first who read by the electric light. In his manuscript, writes Dr. J. Friess in *Zeitschrift fur Elektrotechnik*, I read with regard to the electric light the following:—"When the electric fire has been brought to a proper degree of elasticity, it flows like a continuous light, so that it is possible to read manuscript by it at night."

To describe fully his electrical experiments, would far exceed the scope of this short sketch. We will only just mention that he effected many cures by the aid of electricity. His fame further increased by the construction of a musical instrument, which he called Denysdor. It was 5 feet long, 3 feet wide, and built like an organ. It supplied the place of a whole orchestra. He could also cause the electricity to act, so that the player received a shock as often as Diwisch pleased.

Prince Henry of Prussia offered a large sum of money for the instrument, but during the negotiations which took place, Diwisch died on the 21st of December, 1765.

EXPERIMENTS ON TRANSMISSION OF POWER BY ELECTRICITY BETWEEN PARIS AND CREIL.

By M. MARCEL DEPREZ.

I AM happy to announce to the Academy that the first experiments on the transmission of power by electricity have taken place, and that the results have been very satisfactory.

The length of the telegraphic line connecting the two stations is 56 kilometres, but as the return of the current does not take place by the earth it is really obliged to traverse a line of 112 kilometres of copper cable, equivalent in section to a single wire of 5 millimetres in diameter.

The total electric resistance of this cable at the temperature of 15° C. is 100 ohms.

The generating machine is at Creil. It has two rings revolving in two distinct magnetic fields, each composed of eight electro-magnets. Each ring has a resistance of 16·5 ohms and an external diameter of 0·78 metre.

The current produced by this machine was utilised at La Chapelle by two recipient machines, situate at some hundreds of metres from each other. Only one of these recipients is at present completed. It possesses, like the generator, two rings; they have each 0·58 metre exterior diameter and an electric resistance of 18 ohms.

The experiments, begun on October 17th, took place on a looped circuit; that is, the generating and recipient machines were placed side by side, as took place in the experiments made in March, 1883, in the works of the Railway du Nord, by a Commission nominated by the Academy. The objections which certain persons have raised to this manner of experimenting, which is much better adapted for scientific verification than the transmission to a distance, have been declared groundless by Tresca, with the reservation that we take, be it well understood, all the necessary precautions for measuring, during the experiment itself, the real resistance of the line, which has been actually done.

Between the generator and the steam-engine which sets it in motion there is introduced a very exact dynamometer, analogous to White's dynamometer, which inscribes at each instant upon a band of paper the mechanical work absorbed by the generator. This dynamometer has been studied by M. Contamin, the engineer of the Northern of France Railway Company.

The recipient is fitted with a Prony brake, in which the heating of the friction pulley is rendered impossible by means of a circulation of water. This brake remains in perfect equilibrium for entire hours. Buss tachymeters show at each instant the speed of the generator and of the recipient. These speeds, however, remain constant during the entire duration of an experiment.

We have, therefore, all the elements necessary for determining the mechanical work absorbed by the generator as well as that reproduced by the recipient.

As for the electrical measurements, they have been taken by means of three galvanometers, perfectly graduated, and which show the difference of potential at the brushes of the generator, the difference of potential at the brushes of the recipient, and the intensity of the current traversing the two machines and the line. Two other instruments, lastly, serve for measuring the intensity of the currents produced by small exciting-machines, used for producing the magnetic fields of the generator and the recipient. The indications of all these instruments are of a great exactitude.

I will give in a future communication very complete tables, containing all the electrical and mechanical data of the experiments conducted either by M. Collignon, chief engineer of bridges and highways, or by myself. For the present I will content myself with giving the results of one of the experiments of the Commission, and of another experiment made two days afterwards in the presence of M. Sartiaux, sub-inspector of the Northern of France Railway and engineer delegated by the commission of experiments.

First Experiment.

	Generator.	Recipient.
Speed in rotations per minute..	190	248
Electromotive force, direct or inverse	5469 v.	4242 v.
Intensity of current	7·21 amp.	7·21 amp.
Work in magnetic field (in horse-power)	9 20	3·75
Electrical work (in horse-power)	53·59	41·44
Mechanical work measured with the dynamometer or the brake (horse-power)............	62·10	35·10

Yield.

Electrical	77	per cent.
Industrial mechanical	47·7	„

Second Experiment.

	Generator.	Recipient.
Speed per minute ...	170	277
Electromotive force ...	5717 volts.	4441 volts.
Intensity of current ...	7·20 amp.	7·20 amp.
Work in magnetic field	10·30	3·80
Electrical Work ...	55·90	43·4
Mechanical work (measured with the dynamometer or the brake)	61·	40·

Yield.

Electrical	78	per cent.
Industrial mechanical	53·4	„

It will be seen, and it is to this point that I desire to draw attention, that a useful work of 40 horse-power has been developed by the recipient with an industrial yield of 50 per cent., the speed of the generator being only 170 revolutions per minute, and that of the recipient 277. The electromotive force of the generator was about 5,700 volts. In other experiments it has exceeded 6,000 volts. These machines, therefore, develop considerable electromotive forces with very low angular velocities. It will be remarked, also, that the recipient, though having rings of only 0·50 metre in diameter, and being traversed by a current of only 7 ampères, developed a useful mechanical work of 648 kilogrammetres, without any appreciable heating. These are conditions which hitherto have not been realised.

I cannot conclude this note without mentioning the persons whose assistance has rendered these costly experiments possible; above all, Dr. Herz, editor of *La Lumiere Electrique*, who for two years has defended with the greatest energy, and by all the means in his power, the cause of the electric transmission of force to great distances, and thanks to whom, I have been able to undertake the experiments of Munich, of the Northern of France, and of Grenoble.

The present experiments, the first results of which I have laid before the Academy, have been made with the assistance of MM. de Rothschild.—*Comptes Rendus.*

A New Galvanometer.—Mr. W. Lynd, it is announced, will shortly introduce to the Society of Telegraph Engineers and Electricians a new form of galvanometer which he has contrived for obtaining accurate measurements with the Wheatstone bridge. The galvanometer will have five coils, whose respective resistances will be ·1ω, 1ω, 10ω, 100ω, and 1,000ω.

COPPER RESISTANCE BY FALSE ZERO METHOD.

By C. E. RIMINGTON, School of Electrical Engineering, Hanover Square.

IN Mr. Raymond Barker's geometrical proof of the false zero copper resistance test published in the numbers of this journal for October 10th and 17th, the distribution of potentials is not correctly shown, being more complicated than as indicated by his diagrams. For example in fig. 5, page 330, the potential at E will not be zero, neither will the potential, $e\,p_1$, be as represented. The figures would be perfectly correct if an electrometer or galvanometer of *very* high resistance (so that the current passing through it could be neglected) were employed. As a matter of fact, the galvanometer has to be so shunted that its resistance is generally less than any of the arms of the bridge.

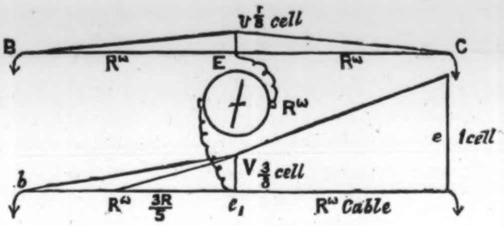


FIG. 1.

Let us suppose, as in his figures, that the resistance of the battery can be neglected, and that the resistance of each arm of the bridge is R^{ω}, the galvanometer also being R^{ω}. Then in fig. 1 the joint resistance of B E and E C $= \frac{R}{2}$, then adding the galvanometer, the resistance between e_1 and earth $= R + \frac{R}{2} = \frac{3\,R}{2}$; and the joint resistance of this and

$$e_1\,b = \frac{\frac{3\,R^2}{2}}{\frac{5\,R}{2}} = \frac{3\,R}{5}$$

Let v represent the potential at E, and V the potential at e_1, e being the E.M.F. of the earth current in the cable = 1 cell. We then have

$$\frac{V}{e} = \frac{\frac{3\,R}{5}}{R + \frac{3\,R}{5}} = \frac{3\,R}{8\,R} = \frac{3}{8}$$

or

$$V = \frac{3}{8}\,e = \tfrac{3}{8} \text{ cell.}$$

Again

$$\frac{v}{V} = \frac{\frac{R}{2}}{R + \frac{R}{2}} = \frac{1}{3} \text{ or } v = \frac{V}{3} = \tfrac{1}{8} \text{ cell,}$$

so that fig. 1 gives the correct distribution of potentials before the application of the battery.

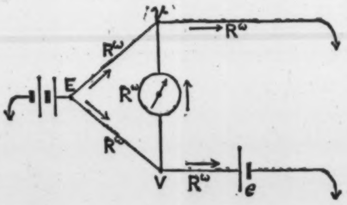


FIG. 2.

When the battery is applied let E represent the potential at the junction of the proportional coils = 2 cells. Then in fig. 2

$$\frac{E - V}{R} = \frac{V - v}{R} + \frac{V - e}{R}$$

$$E = 3\,V - v - e$$

or $$v = 3\,V - E - e = 3\,V - 2 - 1 = 3\,V - 3.$$

Again $$\frac{E - v}{R} + \frac{V - v}{R} = \frac{v}{R}$$

$$E + V - 2\,v = v$$

or $$v = \frac{E + V}{3} = \frac{2 + V}{3}$$

$$\therefore \quad \frac{2 + V}{3} = 3\,V - 3$$

$$9\,V - 9 = 2 + V$$

$$V = \frac{11}{8} = 1\tfrac{3}{8} \text{ cells,}$$

and $$v = \frac{33}{8} - 3 = \frac{9}{8} = 1\tfrac{1}{8} \text{ cells.}$$

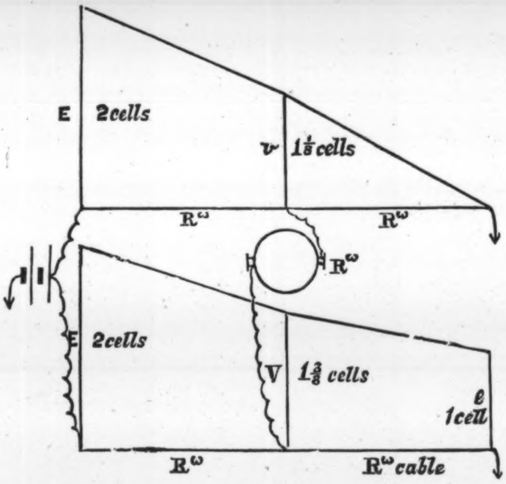


FIG. 3.

So that fig. 3 represents the correct distribution of potentials when the copper pole of the testing battery is employed.

If the zinc pole is used $E = -2$

then

$$v = 3\,V - E - e = 3\,V - (-2) - 1 = 3\,V + 1$$

also $$v = \frac{E + V}{3} = \frac{V - 2}{3}$$

$$\therefore \quad 9\,V + 3 = V - 2 \quad \text{or } 8\,V = -5 \quad V = -\tfrac{5}{8} \text{ cell}$$

$$v = -\frac{15}{8} - (-2) - 1 = 1 - \frac{15}{8} = -\tfrac{7}{8} \text{ cell.}$$

This distribution is represented in fig. 4.

The following may be given as a short proof of this test.

Take the corollary of Bosscha to Kirchoff's laws. "When two branches, A and B, of a system or network of conductors are such that an E.M.F. acting in A sends no current into B, the resistance of A may be varied from zero to infinity without disturbing the condition of B, whatever current may be flowing in the latter due to E.M.Fs. acting in branches other than A."

Suppose R = resistance of A and an E.M.F. E to be inserted in A, and let the potentials at its ends be V and V_1, then the current flowing in it $= \dfrac{V - V_1 \pm E}{R} = \dfrac{V - V_1}{R_1}$; or we should obtain the same current in A if the E.M.F. acting in it were suppressed and its resistance made R_1. But by Bosscha's corollary alteration in the resistance of the conductor, A, makes no alteration of the current in B. Therefore the insertion of an E.M.F. which is equivalent to an alteration of the resistance of A cannot affect the current in B.

We may thus add the following corollary to Kirchoff's laws.

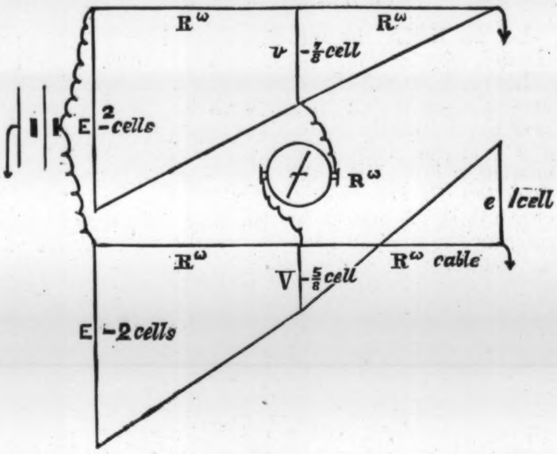


FIG.

If in any system of conductors there be two A and B such that any E.M.F. acting in A occasions no current in B, then if there be various E.M.Fs. acting in the different conductors so that there is a current in B, however the value of the E.M.F. in A be altered, it will occasion no alteration in the current in B.

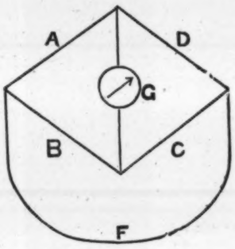


FIG. 5.

In fig. 5 if $\frac{A}{B} = \frac{D}{C}$ by the principle of the bridge any E.M.F. introduced into F will produce no current in G. Let now an E.M.F. be introduced into D; this will cause a current in G. If an E.M.F. be then inserted in F it will cause no difference in the current in G, since when acting alone it was unable to produce a current in G.

We also see from Bosscha's corollary that if the E.M.F. in F be removed, the resistance of F may be varied without affecting the current in G, so that theoretically it is not necessary that the resistance, *br*, should be any particular value, it may be anything from 0 to ∞.

The following is another proof of this test by Kirchoff's laws.

In fig. 6 let A, B, C, D and G represent the resistances of those branches of the bridge.

Let *a*, *d* and *g* represent the currents in the branches, A, D and G, respectively, and be taken as including their signs with reference to the point, P; that is to say, let them be + or − quantities accordingly as they flow towards or away from P.

Let *b* and *c* represent the currents in the branches B and C respectively, and be taken as including their signs with reference to the point Q.

Then $$a + d + g = 0 \qquad (1)$$

and $$b + c - g = 0 \qquad (2)$$

because g if + towards P is − towards Q or *vice versâ*.

Let e be the E.M.F. acting in D, and let it be a + or − quantity accordingly as it acts towards or away from P.

Then from Kirchoff's second law we obtain :

$$a\,\mathrm{A} - g\,\mathrm{G} - b\,\mathrm{B} = 0 \qquad (3)$$

$$d\,\mathrm{D} - g\,\mathrm{G} - c\,\mathrm{C} = e \qquad (4)$$

Let an E.M.F. be now introduced into F, the resistance of which may also be varied at the same time.

Let a_1, b_1, c_1 and d_1 represent the currents in those branches, as shown in fig. 7; these currents may or may not be in the same directions with reference to P and Q as the currents a, b, c and d respectively; the current g, however, is the same both in magnitude and direction in the two cases. Taking as before the currents a_1 d_1 and g as including their signs with reference to the point P, and b_1 and c_1 with reference to Q, we have

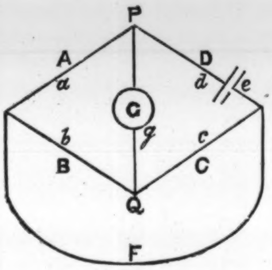


FIG. 6.

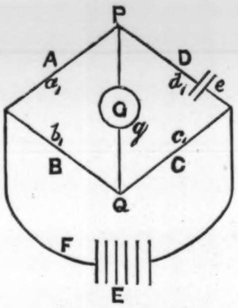


FIG. 7.

$$a_1 + g + d_1 = 0 \qquad (5)$$

$$b_1 + c_1 - g = 0 \qquad (6)$$

$$a_1\,\mathrm{A} - g\,\mathrm{G} - b_1\,\mathrm{B} = 0 \qquad (7)$$

$$d_1\,\mathrm{D} - g\,\mathrm{G} - c_1\,\mathrm{C} = e \qquad (8)$$

From (I) and (5) $a + d = a_1 + d_1$

$$\therefore\ a - a_1 = d_1 - d \qquad (9)$$

and from (2) and (6) $b - b_1 = c_1 - c$ (10)

from (3) and (7) $a\,\mathrm{A} - b\,\mathrm{B} = a_1\,\mathrm{A} - b_1\,\mathrm{B}$

$$\therefore\ \mathrm{A}\,(a - a_1) = \mathrm{B}\,(b - b_1) \qquad (11)$$

and from (4) and (8) $d\,\mathrm{D} - c\,\mathrm{C} = d_1\,\mathrm{D} - c_1\,\mathrm{C}$

$$\therefore\ \mathrm{D}\,(d_1 - d) = \mathrm{C}\,(c_1 - c) \qquad (12)$$

Substituting in (12) the values in (9) and (10) we obtain

$$\mathrm{D}\,(a - a_1) = \mathrm{C}\,(b - b_1)$$

Dividing this by (11) we have

$$\frac{\mathrm{D}\,(a - a_1)}{\mathrm{A}\,(a - a_1)} = \frac{\mathrm{C}\,(b - b_1)}{\mathrm{B}\,(b - b_1)}$$

or

$$\frac{\mathrm{D}}{\mathrm{A}} = \frac{\mathrm{C}}{\mathrm{B}}$$

$$\therefore\quad \mathrm{D} = \frac{\mathrm{A}}{\mathrm{B}}.\ \mathrm{C}$$

Interfering with Telegraph Wires.—At Liverpool Police Court on Tuesday a man named Mitchell was fined £10 and costs for interfering with telegraph wires. Complaint had been made that results of races to certain clubs were delayed. On inquiry it was discovered that Mitchell had diverted the wire at a club in Williamson Square, and thus prevented other clubs from receiving the news, which enabled the manipulator to make bets with certainty, the bets being made at the last moment at the clubs.

NOTES.

The Electric Light in the Royal Navy.—The turret ship *Devastation*, which has taken the place of the *Lord Warden* as coastguard ship at Queensferry, is now fitted throughout with the electric light; this work having been carried out at Portsmouth Dockyard. Besides numerous incandescent lamps placed in every nook and corner of the ship, the vessel has been supplied with two new reflectors for the search lights. Plans have been forwarded to the Admiralty of a scheme for lighting the interior of the turret ship *Inflexible* on a new and improved scale. In case "My Lords" approve of the suggestion the work will be carried out by contract, as in previous cases, the electrical staff at Portsmouth Dockyard not being sufficiently large to carry out such an extensive undertaking.

The Gülcher Electric Light System.—Messrs. Sir W. G. Armstrong, Mitchell & Co. have placed an order with the Gülcher Company for the lighting of their new steel works at Elswick. The installation when complete will consist of two No. 26 slow-speed Gülcher dynamos, each capable of developing 30,000 watts in the external circuit at a speed of 450 revolutions per minute, with, we are informed, a commercial efficiency of fully 85 per cent.; and fifty arc lamps of 3,000 candle-power will be used for lighting these extensive works. The whole of the lamps will be under separate control, with an additional switch placed in the dynamo house, enabling any two lamps to be switched off as desired. New engines of ample power for extending the installation are being fixed, and throughout it is proposed to make this installation as complete and perfect as possible.

The Palmer's Shipbuilding Company, of Jarrow, have also adopted the Gülcher Company's lamps for lighting their new steel works. This installation when completed will consist of about 28 arc lamps and incandescents for the offices.

Messrs. H. J. West & Co. have also shipped a Gülcher plant for the lighting of a large ice factory in India; at present the installation consists of a No. 2 dynamo, 6 arc lamps, and 15 incandescents.

Messrs. Carruthers Brothers, of Luton, have lighted their straw hat factory by means of six 2,000 C.P. arc lamps, dispensing with 200 gas lights; whilst enabling any colours to be accurately judged, which is a matter of great importance in this business, the new light costs only a fraction of the original outlay for gas, and the rooms, which are very crowded, are perfectly cool, enabling more work to be done, and with greater ease to the women employed.

The Coalbrookdale Co. have also adopted the Gülcher system at their large ironworks at Horsehay. The first installation, which will be extended, consists of nine 2,000 C.P. arc lamps, used for lighting the foundry, boiler yard, and upper and lower mill. The light is brilliant and steady, and enables work to be carried on during the morning and evening with the greatest facility. This installation is driven by a No. 3 Gülcher dynamo, and the power obtained from one of the company's new pattern horizontal engines.

Messrs. Monks, Hall & Co., of Warrington, have also ordered an installation consisting of two 3,000 C.P. and one 2,000 C.P. arc lamps, driven by a No. 2 Gülcher dynamo. This installation is now in course of erection, and will be used for lighting their new mill, which has been recently erected.

Messrs. Jonas Brook and Brothers, of Meltham, Yorkshire, have placed an order for the lighting of their Royd Edge Mill with an installation consisting of one No. 5 dynamo and 250 Swan incandescent lamps; but, unfortunately, just before completion the mill was burned down. So satisfied were they with the work which had been erected, that they have since ordered another installation, consisting of a No. 4 dynamo, six arc lamps of 2,000 C.P., and eighty incandescent lamps for the lighting of their dye houses.

Messrs. F. B. Welch & Co., Manchester, the company's agents, have recently supplied a contractor's plant for the lighting of some extensive works at Horwick, near Manchester. This installation comprises one No. 2 dynamo machine and six 2,000 C.P. arc lamps; the engine room being lighted by means of incandescent lamps, driven by the same machine.

The Whitefriars Printing Company, which does a large amount of photography, has ordered two Gülcher arc lamps for its special requirements, and has also placed the order with the Gülcher Company for the re-arrangement of the electric light plant.

Beyond these installations for lighting, the company is busily engaged upon the manufacture of dynamo machines for electro-depositing, and a considerable number of large dynamos, capable of depositing from six to eight tons per week, have already been supplied with the greatest satisfaction to customers. Amongst other specialities, the company is supplying a considerable number of small projector lamps.

Club Lighting.—At the dinner given to the Liberal candidates for the Liverpool constituencies, on Monday evening, the 26th ult., the dining saloon of the Junior Reform Club was lit up for the first time by the electric light. The work was carried out in a satisfactory manner by Mr. W. H. Fleming, electrical engineer, of Baliol Chambers, Stanley Street. The motive power for driving the Elwell-Parker dynamo machine was from a gas engine situated in the basement of Baliol Chambers. The number of lamps in circuit amounted to 50 Edison-Swan 45 V. 16 C.P.

Electric Lighting in New England.—The electric light plant installed at Waterbury, Conn., a little over a year ago by the Connecticut District Telegraph and Electric Company, is said to be one of the most perfectly equipped plants in New England. The system in use is that of the Thomson-Houston Electric Company, and the four dynamos are from the factory of that well-known company, Lynn, Mass. The lighting capacities of these dynamos are respectively: One of 45 lights, one of 30 lights, and two of 28 lights. The two 50 H.P. automatic cut-off engines are from the shops of the Armington and Sims Company, and the 100 H.P. boiler, with Jarvis setting, was put in by the Jarvis Engineering Company, of Boston. The number of arc lights furnished by this plant is 102, and orders are just beginning to be filled for incandescent lights run off an arc circuit. The demand for more arc and incandescent lights has compelled the promoters of this enterprise to put in an additional dynamo of 45 arc lights capacity, another engine of 60 H.P., and one more 100 H.P. boiler, all of the same make as those above-mentioned, respectively.

The Latest Developments in Electric Lighting.—Under the auspices of the Greenock Philosophical Society, Professor Jamieson, C.E., F.R.S.E., Principal of the Glasgow College of Science and Art, will deliver, on the 13th inst., a lecture on "The latest Developments in the Electric Lighting of Houses and Ships," illustrated by diagrams and specimens.

Football by Electric Light.—Mr. Charles Lever lighted the football field at Tunstall on the occasion of a recent match, with six of his arc lights of 2000 nom. C.P., each placed on poles about 30 feet high, and provided with specially arranged globes to reflect the light, and the ground was said to be effectively lit up. The same evening, ten similar lights were used to illuminate the Market Hall, wherein a promenade concert was held. The following night, a ball was given in the Town Hall, and five lights lit up the front of the building. An engine had been provided in some neighbouring mills for working the special Gramme dynamo, but Mr. Lever found it advisable to use a portable engine in addition, the work being divided between the two.

Telephonic Experiments.—We are indebted to the courtesy of Prof. Chas. R. Cross for the interesting paper descriptive of experiments made with the thermal telephone which we publish this week.

The Western Counties and South Wales Telephone Company.—This company, during its comparatively short existence, has manifested considerable activity and enterprise. We are pleased to note that the Telephone Exchange which not long since was established at Portsmouth is now receiving a larger share of support than was at first accorded it, for already most of the large houses of business are on the Exchange. It is to be hoped that before long all-night communication will be conceded by the company. An illustration of the utility which this would be occurred a short time since. A serious fire broke out in an oil shop in Queen Street, one of the most busy and populous thoroughfares in the town. As soon as the outbreak was discovered efforts were made to telephone the alarm to the central station by means of the exchange, but on the exchange being "rung up" from the *Evening Mail* office close at hand it was found that the operators had left. Had the exchange been open the fire appliances might have been on the spot at least five minutes sooner, and time in this instance was of the utmost importance, as the conflagration spread with amazing rapidity, owing to the inflammable nature of the goods on the burning premises. It is expected that before long the company will be enabled to establish an exchange at Southampton, which is a large and important town, carrying on a considerable trade with South Africa and other colonies, and having also a large ship building trade. The company has also been devoting some attention to Bournemouth, canvassing for subscribers for opening an exchange to embrace the adjacent towns of Poole and Christchurch. The promises which have been given point to the venture being a success.

The Bell Patent in America.—The *Electrical World* says:—"Another attempt is to be made to test the validity of the Bell patent. This might have been expected. We may be sure that the 'technicalities' will be observed this time." In the same journal we read that the United States Attorney for the Western District of Tennessee, Mr. H. W. McCorry, has renewed his application to the Department of Justice to test the validity of the Bell telephone patent, and a similar application has been made by the Washington Telephone Company, of Baltimore, and both applications have been referred to the Interior Department for investigation.

A Telephone Exchange Burnt Down.—The St. Louis Exchange of the Bell Telephone Company caught fire on October 18th, and the machinery of the company was destroyed.

Telephoning from Lightships.—The Telegraph Construction and Maintenance Company has for the last eight months had several of its best operatives located in the neighbourhood of the Naze, off which the most dangerous sands round England are to be found. These gentlemen are hourly in communication by telephone with a lightship which is anchored ten miles out in the vicinity of the Swin passage. An ordinary telegraph cable has been laid from Walton-on-the-Naze to the sunk lightship, and telephone and telegraphic apparatus have been affixed to both ends. Mr. Stevenson, one of the company's officials, has been on board the sunk lightship a month, and has experienced all kinds of weather, during which time he kept Mr. Lewis and Mr. Pinkerton, his colleagues on shore, fully informed by telephone of the state of the weather, roughness of the sea, and passing craft, adding frequently forecasts of weather which usually turned out to be correct. Every ship passing is duly signalled, and her name and description telephoned to the Walton Post Office. On an average, 90 ships pass in the day, and if it was known that messages could be sent ashore, no doubt the majority of these would avail themselves of the benefit. A considerable number of the ships passing have come great distances without passing one of Lloyd's signalling stations. The signalling of these passing the Sunk lightship would be of great commercial value, as their time of arrival at any port they were bound for could be timed by the owners in London accurately, and everything could be made ready for the landing and the sale of the cargo. Of much more importance is the use the telephone could be put to in a storm, or in the case of a ship getting on the sands. One night this year, in a rough sea, a ship did get on a sandbank, and instantly her exact position was telephoned to Walton from the lightship. The gentlemen at Walton awoke the lifeboat crew and telegraphed to Ramsgate and Harwich, where the lifeboats were got ready for launching. Just as all three lifeboats were about to start, a telephone message came from the lightship that the ship in distress had got safely off the sandbank, and that there was no need for the lifeboats to start. The boats were stopped, and if it had not been for the telephone they would have been out on the rough sea all night searching for the ship that had sent up distress signals. The Sunk lightship is only 150 tons, and yet only once in the stormiest sea, when she had been tossed about in a gale of wind, has the telegraph wire been broken. The two ends of the break were picked up and rejoined within 24 hours. The Trinity Board is showing considerable interest in the experiment, and it is hoped that it will see the great importance of at once putting, by this means, the chief lightships in communication with the shore.

Sixpenny Telegrams.—Although the Post Office authorities are unable at the present moment to furnish a tabulated statement showing in actual figures the working of the sixpenny telegram system during the few weeks it has been in operation, says the *Standard*, they have nevertheless had sufficient experience of its working to satisfy the Telegraph Department as to the success that has hitherto attended the cheapened rate, and the still greater success they may fairly anticipate. Taking only the ordinary paid inland telegrams, exclusive of press and other messages of a special character, the increase during the first completed week in October reached 33 per cent., which is 3 per cent. beyond the original estimate for the entire year. During the second completed week the increase was 44 per cent., but in the third week there was a fall in the percentage of from 44 to 39. This, however, need hardly be regarded as discouraging, inasmuch as, in comparison with the corresponding period of the previous year, the depressson then experienced was considerably greater in proportion to the then charges than the slight falling off recently experienced. The average price paid for telegrams during the past month has been about 8d., as contrasted with an average under the 1s. system of 1s. 1d. Of the large number of telegrams transmitted under the reduced rate, about forty per cent. are attributable to the sixpenny rate, and there is little doubt that the extra halfpence as between the minimum and the average charge have been contributed to an appreciable extent by those who as yet have had little exercise in the art of condensation. The increase of private telegrams in the motropolis has been really enormous when compared with the general increase throughout the United Kingdom, for whereas the total percentage of increase has fluctuated between 33 and 44 per cent., the increase in London alone has amounted to considerably over 60 per cent. There has been a proportionate increase in several of the largest of our provincial towns, notably Liverpool, Glasgow, and Manchester.

Intercepting Telegrams.—Two men were charged at Bournemouth on Tuesday, and remanded on bail, with fraud in connection with betting transactions; they were accused of having intercepted a telegram at Ringwood.

Telegraphic Addresses.—On page 3 of the supplement to this issue (in centre of paper) we publish the first list of "Telegraphic Addresses." We shall be pleased to receive any addresses not yet contained therein or those of any firms who will send them on registration being effected, as amended lists will from time to time be issued by us.

Submarine Telegraphy in France.—We learn from Paris that the Société Générale des Téléphones has decided to erect submarine cable works in one of the largest ports of France. The site spoken of is alongside one of the deepest docks, so that the cable steamer may be placed conveniently near the factory while shipping the cables manufactured there. The French journals congratulate the Société Générale on their decision to build this factory, as they consider it a work of national importance, which will place France in the position of being no longer indebted to foreign countries for her submarine cables. The French Administration has a cable factory at La Seyne, near Toulon; but as these works belong to the government, private contracts, although of importance to France, cannot be undertaken. The factory at Beyons belonging to the Société Générale des Tèléphones, was purchased by that company from Messrs. Rattier & Co., and, from its position, does not offer facilities for submarine work, nor are there two other cable manufacturers better placed, Menier's works being situated some distance from the Seine, and the Silvertown Company's works a considerable distance from the banks of the River Oise. The managing director of the Société Générale des Téléphones, to whom this initiative is due, is M. Richard, formerly directeur ingénieur in the government service. This gentleman has had a good deal of experience in submarine telegraphy. It is also rumoured in Paris that, in view of large contracts in the near future, a German cable manufacturer in Cologne thinks of interesting himself in a new submarine cable manufactory in France.

Subterranean Telegraph Wires.—Dr. Norvin Green, President of the Western Union Telegraph Company, in an examination before the New York Electric Subway Commission, admitted that the whole system of wires could be carried underground through 3-inch iron pipes filled with paraffin oil, but there was the impediment of cost. He said, "There is not much difference in the cost of putting down one wire and 100, but we certainly would not attempt to lay single wires in all our lateral branches underground. The number of wires that we can place in a 3-inch pipe depends upon how heavily we insulate them. In round figures, a wire insulated with gutta percha and placed underground, costs about $100 a mile, while a wire overhead costs about $23, and the buried wire will not last one-third as long as the one strung on poles. In fact, wires will not be serviceable so long underground as they are under water. We have wires in this country that have done service for 30 years and are still good. Many underground wires have to be replaced after a year's service. Everything depends on the nature and thoroughness of the insulation. Our company have spent a great deal of money experimenting on insulation, and we have found nothing yet that will render a wire as lasting underground as it is in the open air.

Copper Telegraph Wires.—It will be remembered that at the British Association meeting Mr. Preece stated that in a trial of iron and copper telegraph wires of a length equal to the distance between London and Newcastle, the speed of transmission with copper was 414 words per minute, whereas iron gave 345 words. Mr. Preece thought the gain of speed was due to a greater electrical susceptibility of copper, as compared with iron. His opinion, according to *Engineering*, is borne out by Prof. Hughes, who is at present engaged in investigating this phenomenon with the induction balance. Prof. Hughes finds that copper is more sensitive, molecularly speaking, to changes in an electric current, than iron is. For example, he finds it impossible to balance a copper against an iron wire of exactly the same resistance in the Wheatstone bridge, until after a definite but very short time which the current takes to attain its maximum in the iron wire. This effect, which is not noticeable with the ordinary galvanometer, is, in his opinion, not entirely due to the electrostatic capacities of the wires, but to some molecular inertia or peculiarity of their molecular construction.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to October 31st, 1885, were £1,080,000, the exact amount received last year from April 1st to November 1st.

The Cable Ship "Dacia."—This vessel, belonging to the India Rubber, Gutta Percha and Telegraph Works Company, arrived at Aden, all well, on the morning of the 2nd inst.

Cable Rates to Australia.—It is understood that the tariff for cable messages between England and South Australia is to be reduced as follows:—Private messages to 8s. 8d. per word, and press messages when the line is clear to 2s. 8d. per word.

Elieson's Electric Motor.—An electric motor (C. P. Elieson's Patent) has for some time past been tested and run at the works of the North Metropolitan Tramway Company, Union Road, Leytonstone. The motor will be removed in a few days to the Stratford Depôt, whence public trials will be made. An extension will shortly be made of the tramway from Stratford down the Ilford Road, and arrangements are to be made later on to work this portion entirely by electricity. Meanwhile, a motor of greater power is being constructed with the view of showing what can be done on a railway. The following special advantages are claimed for the motors: (1) They can be placed upon any existing line of tramway where horses are employed without interfering in any way with the arrangement of the cars or the permanent way, and the electrically-propelled cars can run alternately with horse-cars where required. (2) The cost of an installation of charging station and locomotives to replace horses is considerably less than the cost of the horses, harness, and stabling, while the maintenance is quite 40 per cent. less. (3) The apparatus is perfectly under the control of one attendant, who need not be a skilled electrician. (4) The cars or carriages can be splendidly illuminated by the same current of electricity that supplies the power to the locomotive, the fraction so used being inappreciable. (5) The enormous tractive force developed by the special electric locomotives which the Electric Locomotive and Power Company proposes to manufacture, enables the traction upon railway lines, where smoke and steam are objectionable and prejudicial to the health of passengers, to be carried out electrically with economy. (6) The absolute safety of the system, the low tension current employed being perfectly harmless. The maximum of speed developed by the motor under notice is about eight miles an hour, but one can be constructed to run as slow or as fast as may be required. The power is derived from 50 cells of about 250 ampère hours capacity, and the current varies from about 60 ampères at starting to about 35 ampère hours when running.

Prospectus Misrepresentation.—Mr. Justice Chitty last week made an order, upon the application of Mr. Emanuel Gaminara and other shareholders of the London and Provincial Electric Lighting and Power Generating Company, removing their names from the register of shareholders. The ground of the application was the alleged misrepresentation in the prospectus.

The "Great Eastern."—This steamship was sold last week to Mr. Frederick De Mattos, a City merchant, for £26,200, and is to be permanently moored at Gibraltar as a coal hulk.

International Exhibition at Edinburgh.—An International Exhibition of Industry, Science, and Art, is announced to be held in Edinburgh during the summer of 1886, under the patronage of Her Majesty. This is the first International Exhibition ever held in Scotland, and a prominent feature will be to illustrate the material resources, manufactures, and art treasures of Scotland. The classification will be as follows:—Class I. Minerals, Mining, Quarrying, and Metallurgy.—Class II. Pottery, Glass, and kindred Industries.—Class III. Chemistry, Pharmacy, and Food.—Class IV. Animal and Vegetable Substances, and their Manufacture.—Class V. Paper Manufacture, Stationery, Printing, and Bookbinding.—Class VI. Prime Movers. 1. Steam Engines (Marine and Land), Gas, Electric, Hydraulic, Hot Air, &c.; Water-Wheels, Turbines, Steam Pumps, &c.; 2. Boilers, Smoke-consuming Apparatus, &c.; 3. Accessories of Engines or Boilers.—Class VII. Manufactures in Metal.—Class VIII. Railway, Tramway, and Vehicular Appliances.—Class IX. Civil and Military Engineering, Building, Construction, Shipbuilding.—Class X. Furniture and Decoration.—Class XI. Scientific Appliances: Models of special apparatus for Illuminating (electrically or otherwise), Heating, or for Motor Power, for Domestic purposes, such as Oil, Gas, Hot-Air, and Electric Engines; Surgical, Medical, Mathematical, Meteorological, Astronomical, and Nautical or Military Adaptations of Scientific Inventions of novel application or design; Clocks, Watches, &c., in progress of manufacture, &c.; Photographs, Drawings, or Illustrations of quaint design of any Instrument or Apparatus of antiquarian interest in this Section may be exhibited.—Class XII. Educational Appliances.—Class XIII. Sea Industries.—Class. XIV. Fine Arts.—Class XV. Reproductions of Old Buildings or Old Streets, or Portions of these.

Something Wrong Somewhere.—Has Mr. Holroyd-Smith been deceiving the public and everybody else as to the powers of his system of electric locomotion on tramways by resorting to the secret use of accumulators? Or has the *Graphic*, presuming on the ignorance of its readers as to technical matters, brought out an old block intended to represent the Reckenzaun system exhibited at Kew some two years ago?

Underground Cables.—We have received a copy of the new cable pamphlet of the Kinetic Engineering Company, wherein we find a translation of Dr. Borel's "Instructions for the Laying and Jointing of Underground Cables."

The Blackpool Electric Tramway.—Last week's *Mechanical World* stated that "the second or southern portion of the Blackpool electric tramway has now been cleared from its obstructions, and the tube conductors freed from the tar which covered them. Some inconvenience is experienced at the points at two or three places along the line, and despite the utmost care the car not unfrequently gets upon the wrong line. It is also stated that sudden and unexpected stoppages occur with the new cars, and of considerable duration. It is to be hoped that the tar-cleaning of the south section did not cost so much as that of the north, which amounted to £150, as stated by the Company's managing director. Some persons of an inquiring turn of mind have been testing the conductors by passing the blades of their knives down the channel, with the results of violent shocks to their system and the melting of the knife blade."

Tenders Invited.—The Cheshire Lines Committee asks for tenders for telegraph materials, instruments, wire, &c., to be addressed to the Stores Department, Warrington, by the 26th inst.

The Explosion at Hell Gate.—Last week's columns of *Engineering* contain an interesting and lengthy article on the explosion which resulted in the disappearance of Flood Rock from the entrance to New York Harbour.

Agency.—We are informed that Mr. H. C. Harold, of 30 and 31, St. Swithin's Lane, E.C., has been appointed the sole agent for the sale of the electric light carbons, battery plates, and electrodes, manufactured at the works of the Liepmann Carbon Company, Limited, Millwall, E. Speciality—"Cored" Carbons of superior manufacture.

Electrical Lectures.—In the rota of lecturers for the 1885-6 session at the Franklin Institute, Philadelphia, are the names of the following gentlemen, with the subjects on which they will lecture:—Nov. 13, Lieut. Bradley A. Fiske, U.S.N., "Electricity in Warfare;" Dec. 11, Prof. A. E. Dolbear, Tuft's College, Mass., "Telephone Systems;" Jan. 25, Mr. C. J. Kintner, Chief Examiner, Department Electricity, U.S. Patent Office, Washington, "The United States Patent Office Historical Electrical Apparatus;" Feb. 8, Prof. M. B. Snyder, Central High School, Philadelphia, "The Relations of Pure Research to the Electrical Exhibition;" March 1 and 8, Mr. Carl Hering, Philadelphia, "Dynamo Electric Machinery;" March 15, Captain Otho Ernst Michaelis, U.S.A., "The Function of Electricity in the Development of Marksmanship, or Electro-Ballistics." A note at the end of the list states that the lectures of the physical course are chiefly upon subjects bearing upon the International Electrical Exhibition of 1884, by gentlemen who were personally engaged in scientific work connected therewith.

Daft Motors.—Two trains of cars run wholly by electricity will soon, we learn, be in regular operation on the Ninth Avenue Elevated Railroad, New York, with Daft motors, of the same kind as those recently tried there successfully. Arrangements are being made to equip a twelve-mile road in Hamilton County, Ohio, and negotiations have been entered into for supplying surface roads in Pittsburgh and Brooklyn.

Waterbury Watches and Dynamos.—There is stated to be a large demand for Waterbury watches among electricians in America, and there is no reason why they should not find equal favour in this country. They are cheap and efficient, and resist magnetic influences as no other watches do.

New York Electrical Society.—The first meeting for the season of this Society, formed last year, took place on the evening of October 14th. The discussion of the subject, "Protection from Lightning," was opened by Dr. Vander Weyde, who gave short historical reminiscences relating to the question, and followed it by reciting the rules to be adopted for efficient protection. He was followed by several members, and several amusing anecdotes of careless methods adopted were related. The Society is growing rapidly, ten new members being proposed at the last meeting.

Electric Engine Company, Limited.—The name of this Company figures in the recently issued list of joint-stock companies that have been struck off the register and dissolved.

Personal.—Mr. Joseph Wilson Swan and Mrs. Swan have been elected members of the Royal Institution of Great Britain.

Sale of an Exhibit.—We are informed by Messrs. Shippey Brothers that Messrs. Fuller and Son, telegraph engineers, of Bow, have purchased their entire electrical exhibit shown in the East Arcade at the Inventions Exhibition.

The International Exhibitions.—The *Gas and Water Review* has frequently animadverted upon the gross injustice of the system of jury awards at the International Exhibitions at South Kensington, and last week, in the course of an article on the subject, gave vent to the following query: "Who will be so rash as to assert that the executive and higher officials are absolutely independent and unbiassed in matters regarding the electric light?"

Telephone Rates at Hull.—Mr. Alderman Leak, as secretary of the Hull Guardian Society, recently forwarded to Lord John Manners, the Postmaster-General, a memorial signed by all the telephone renters in Hull, praying for a substantial reduction in the charges made for the use of telephones. To this memorial a reply has been received to the following effect: "Sir,—I am directed by the Postmaster-General to acknowledge the receipt of your letter of the 10th inst. forwarding the memorial from the merchants of Hull, asking for a reduction in the rates for telephone exchange wires in that town, and in reply Lord John Manners desires me to acquaint you for the information of the memorialists that renewed consideration has been given to the question, but he regrets to find he is not in a position to recommend the Treasury to make any reduction in those rates. I am, sir, your obedient servant, C. H. B. PATEY."

Bankruptcy Proceedings.—The adjourned examination of David Hunter, otherwise known as Graeme Hunter, lately carrying on business as electricians under the firm of Graeme Hunter & Co., in Sauchiehall Street, Glasgow, and now in Maxwell Street, Glasgow, was held last week. The trustee being satisfied with the private explanation of the bankrupt's affairs, the examination closed.

The public examination of Mr. Newson Dunnell Garrett, of 23, Poplar Grove, West Kensington, a major in her Majesty's Royal Artillery, half-pay, came on for hearing at the London Bankruptcy Court last week, before Mr. Registrar Brougham. The receiving order was made upon the petition of the Gulcher Electric Light Company, Limited, creditors for £987 10s. 5d., in April last. The first meeting was held in June, when it was resolved to adjudicate the debtor a bankrupt, Mr. Kirby being appointed trustee of the company. The accounts filed show debts fully secured £9,000, the value of the securities being £15,000; debts partly secured £1,824 15s. 11d., the securities being valued at £300; debts unsecured £3,204 18s. 1d., and assets £6,000 surplus from securities. The examination was adjourned. Major Garrett has written to the *Standard* stating that the petition was proceeded with during his enforced absence from England on a voyage to New Zealand, and asserting that he does not owe the Gulcher Company a penny.

A Scene in Chicago.—It is reported from Chicago that a broken electric light wire there became connected one night with an iron pillar. This passed the electric current along a hand railing, and it, returning by another railing, made a complete circuit. A negro came along and leaned wearily against the railing. Then he bristled up with energy. His arms were closed around the railing and his body was bent like a letter S. He had no idea what was the matter with him, and being unable to let go his hold, cried out loudly that he was dying. A dozen men ran to his assistance, and were soon experiencing the tingling effect of the electricity. Some laughed, others cried, and many called for help. A crowd soon gathered, and a few additional victims were hanging to the railing. Finally the crowd numbered nearly five hundred. Cars were stopped and no one could get past. A police waggon arrived just as an enterprising man had discovered the cause of the trouble and released the victims by disconnecting the wire.

A Town in Darkness.—An accident occurred in charging the holders at the Oldbury Gasworks on the night of the 21st ult., resulting in the extinction of all the lights in the town.

Leather Belting.—The New York *Electrical Review* states that for testing the quality of leather used for belting, Mr. Eitner proposes the following simple method:—A small piece is cut out of the belt and placed in vinegar. If the leather has been perfectly tanned, and is, therefore, of good quality it will remain immersed in the vinegar, even for several months, without any other change than becoming of a little darker colour. If, on the contrary, it is not well impregnated with tanning, the fibres will promptly swell, and, after a short time, become converted into a gelatinous mass.

Signalling by the Electric Light.—Mr. A. C. Sanders writes in the Bloemfontein *Daily News*, claiming to have preceded Mr. Eric Bruce in inventing a system of signalling by means of the electric light, his system being as follows:—For ships at sea, have an electric lamp placed at the masthead to signal from ship to ship or ship to land; for inland communication, lamps fixed on prominent points, with wires laid on from a dynamo, broken by a Morse key (or something similar) to break the current, thus giving short and long flashes, the Morse alphabet being used. This invention is not the subject, so far, of a patent, but Mr. Sanders has "written to a firm asking them to patent it."

The William Spottiswoode Memorial.—A meeting of the committee was recently held at the rooms of the Royal Society of Literature, under the presidency of Mr. Warren De La Rue, chairman. The business of the meeting was to receive from the treasurer (Mr. Samuel Spalding) a financial statement, and to close the fund. The secretary (Mr. J. S. Hodson) submitted a draft report, which was adopted by the committee, and directed to be forwarded to each contributor, announcing that the sum of £690 6s. had been handed over to the Printers' Corporation, with which to establish the William Spottiswoode Memorial Pension for incapacitated printers, or widows of printers.

NEW COMPANY REGISTERED.

Parker's Electric Wire Corporation, Limited.—Capital £100,000 in £5 shares. Registered office, 9, Bridge Street, Westminster. Object: To purchase and work the letter patent No. 4781, A.D. 1883, for "Improvements in conductors of electricity." Signatories (with one share each): Edward Easton, C.E., 11, Delahay Street; E. R. Robson, 9, Bridge Street, Westminster; J. S. Green, 1, Gresham Buildings, W.C.; B. Blenkinsop, 15, Earlsfield Road, Wandsworth; E. Andrew, Palace Chambers, Westminster; H. M. Winch, 43, Horsleydown Lane, S.E.; J. G. Parker, C.E., 11, Queen Victoria Street. Registered without articles of association on the 2nd inst., by Mr. Edwin Andrew, 9, Bridge Street, Westminster.

DEFUNCT COMPANY.

Electric Engine Company, Limited.—This company, having failed to comply with the requirements of the Companies Acts, has been struck off the register. It was incorporated on the 7th of March, 1876, with a capital of £200,000 in £5 shares, to purchase the letters patent No. 2049, A.D. 1875, and No. 4118, A.D. 1875, both for improvements in electro-magnetic motors, the vendors being Messrs. Lyle Nelson and Edwin Lucas Pain, of 9, Cecil Street, Strand (electricians). The only return filed by the company was registered on the 31st July, 1876, and is made up to the 20th of that month. 38,263 shares were subscribed for, and upon 300 of these the full amount had been paid, the remainder being considered as fully paid.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Electric News Telegraph Company, Limited.—The final winding up meeting of this company was held on the 24th ult., when an account was laid before the shareholders, showing the way in which the winding up has been conducted and the property of the company disposed of, pursuant to section 142 of the Companies Act, 1862.

Pall Mall Electric Association, Limited.—At an extraordinary meeting of this company, held at No. 1, Rathbone Place, on the 7th July, it was resolved to wind up voluntarily, and Mr. Cornelius Barnett Harness, of Clee House, Lavender Hill, was appointed liquidator. This resolution was confirmed on the 30th of that month and duly registered on the 29th ult. The final winding-up meeting of the company was held on 2nd inst., in conformity with section 142 of the Companies Act, 1862, when an account was given of the way in which the winding up has been conducted and the property disposed of.

CITY NOTES, REPORTS, MEETINGS, &c.

Direct Spanish Telegraph Company, Limited.

THE twenty-fourth ordinary general meeting of this company was held at the Cannon Street Hotel on Friday, the 30th ult., Sir James Anderson presiding, and only about a dozen shareholders being present.

Mr. Charles Gerhardi, the Secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been confirmed,

The Chairman said: Before moving the adoption of the report I will, as usual, make a few observations. All that will be new, I think, will be in reference to the Telegraph Conferenee, because I find, on looking at what I said last April, that if I said the same things again they wonld answer the purpose quite well. I told you then we were doing all we could to get a wire through Spain to Carthagena, and a better wire between Madrid and Bilbao; that a commercial treaty was about to be concluded betwixt Great Britain and Spain, and that the traffic was interfered with by the cholera. The Spanish treaty has not yet come off, neither have we got the line to Carthagena, although we had the greatest influence possible brought to bear on the point, and spent some money—not of this company—in trying to get it; also the cholera has prevailed ever since, and is now worse than ever; so that we have not got to any satisfactory point as regards the traffic. In addition to these prevailing misfortunes, trade has been very much depressed, as we all know, and our cable broke the other day. I am happy to say, however, that our ship arrived on the spot this morning, and as she is a very fine vessel, with an experienced captain and crew, we are in hopes of making a speedy repair, although the cable is broken in 2,000 fathoms of water. Now, gentlemen, these are the bad sides of the story. I am always sorry for the breaking of the cable, and now it seems very extraordinary, for I cannot account for it, unless there has been some convulsion at the bottom of the sea. Up to the time the cable broke the traffic was increasing rapidly, and, indeed, I have not seen so large a traffic for some years as we have had within the past few weeks. I see no other outlook for this company except in the growth of the traffic. There is no use in beating about the bush and trying to make it look more pleasant and nice than it is. That the increase will come I am in hopes, but until it does there is no hope. With regard to the Berlin Conference, you will ask what was done there. When Mr. Gerhardi and I, representing this company, went to Berlin, the outlook was as gloomy as possible. If the rates were adopted which Germany and, amongst others, Austria desired, the Direct Spanish Company would have been wiped out entirely. The general feeling, I thought, was against the cables at first. There was an idea amongst many of the delegates that cables were a matter of luxury, and not of much use. But that opinion had not much weight. In the course of a fortnight or so they began to find that, for external commerce, cables were not only not a luxury but were indispensable, so much so, that they were termed the normal route. Speaking off-hand, this country does 75 per cent. of the telegraphy of the whole world—I mean of the external telegraphy—and therefore we are more dependent than any other country upon the telegraphic means of communication between these shores and those of other States. We received cordial support from the representative of the English Post Office, Mr. Patey, and Col. Champain, who represented India, and these, as well as Spain and France and other Mediterranean States upon whose shores the cables of private companies are landed, insisted upon our cables being called the normal route In times of revolution and war and great storms on the Continent, these cables were indispensable, because of the interruption of the land lines. Added to that, their being in private hands and worked direct, and not in transit passing through a number of States speaking different languages, secured for our cables recognition as normal routes, and therefore there came to be a better feeling towards us, for, after all, they were sensible men. I must speak with praise of the assiduity of Mr. Charles Gerhardi, who, speaking several languages, mixed with the delegates in a genial way, and got more out of them, I think, than any other company. Those States on whose territory cables landed had to raise their rates in order to give us something, and they gave us so much that we are very little the worse for what was done. All through the published records of the telegraph receipts of the different Administrations there is nothing, with but very few exceptions, but very large deficits, one State losing £210,000, another from £50,000 to £60,000; four or five of the larger States have fused their postal and telegraph receipts, so that nobody can tell how much they are losing on the telegraph receipts. These States thought from the advantages they derived indirectly in promoting commerce, that they could afford to lose money on their telegraph administrations. In former years, during all the conferences I have been at for the last fifteen years, the governing principle was that in telegraph administration the revenue must pay the expenses, and upon those lines the tariffs were adjusted. But now Germany has insisted for some years, and especially at this conference, that that should not be the governing principle, the desire being on the part of all European States, as you know, judging from the colonial fever which has set in, to extend their commercial relations to greater limits, and to increase the facilities for spreading commerce betwixt distant colonies and outside countries and centres where emigrating populations arise; and so it was the great aim and effort on the part of Germany and Austria, and some other States, to disregard the tariffs of almost anybody, and bring down telegrams to a price that they very soon saw, when it came to be discussed, would not allow these cables to be maintained. The result, happily, was that they recognised this principle, and the tariffs were so adjusted that I do not think this company will lose anything. The aggregate loss which we can sec seems to be £1,400, and assuming that the reductions made by some of the States, whereby they will lose 40 per cent., will increase the traffic on our lines, I do not think we shall lose anything. I dare say our tariff will be 4½d. instead of 6d.; and in exchange for that we have cheaper telegrams on the Continent likely to give us more traffic. That is the position in which we stand with regard to the Berlin Conference. I cannot think, for the future of this company, that there is anything for it but an increase of traffic to a large extent; and we could carry four or five times any traffic I have seen yet, so that we have plenty of carrying power. With those remarks, I now move the adoption of the report.

Mr. Etlinger seconded the resolution.

Mr. Dyet asked when they were likely to get the old cable to work. He supposed they could not tell until it was examined whether it was likely to be of any service, or whether it would be better to abandon it altogether.

The Chairman said his opinion was that they must take the whole thing very gingerly, and not be in a hurry to spend a lot of money on what might prove not worth repairing. They lost the cheapest ship they could get last year, unfortunately, and he had thought proper to recommend to his colleagues nct to spend any money now in chartering another ship. The cable was doing no harm, and he should like to be left free to lay hold of it when they could and examine it; but it was nearly winter now, and the summer only was a suitable time for the purpose. He was at Constantinople the other day, and there saw the captain who last repaired the cable, and he was very doubtful if it was worth repairing again.

Mr. Beard suggested that it was better to abandon the cable altogether. He had held that view all along, and he was confirmed in it by what the captain said.

The Chairman: Yes; but he cannot see to the bottom of the sea any more than we can.

Mr. Cochrane said at the last meeting he asked the chairman to submit the precise opinion upon which the board decided not to pay the preference dividend. As the solicitor was now present he would repeat his rcquest. He thought that touched the whole question all round. But there were beyond that very serious questions, and he thought the position of the company demanded a far greater interest than the paucity of members present showed the shareholders had in it. The proxies showed that practically they were in the hands of the Eastern Telegraph Company; that was an excellent company, but he submitted that it was rather a precarious thing that they had two representatives of the Eastern Company on the board and only one representative of the shareholders of this company. He thought the time was come when they ought to have some change in the constitution of the board. The chairman had just spoken about employing an Eastern ship to do the repairs. If he was not mistaken, shareholders of other companies who were on the board were precluded from voting for the employment of the ships of those companies; there could consequently be no majority of the board to decide that. He thought if this question were to assume a proper form they ought to have some slight alteration in the character of the board, and, suggesting nothing disrespectful to the two representatives of the Eastern Company, if they were to have any hope of getting out of the everlasting slough they were now in, a change must take place. The company had been a most unfortunate one as far as his connection with it was concerned, and he only hoped that it would be absorbed by the Eastern Company; but how, under present circumstances, such an arrangement could be arrived at there was difficulty in saying. He did not wish to speak too strongly of the conduct of the past board, but it seemed to him amazing that arrangements were arrived at with the Eastern Company, which held something like £100,000 of their small capital, without steps being taken for the protection of the shareholders. They could never pay a dividend to the ordinary shareholders, or, indeed, any dividend, until their capital was intact; but their capital could never be intact except upon two suppositions, the replacing of the broken cable or the reduction of the capital, and either of these courses was open to objections. He was strongly of opinion that some committee should be appointed to meet with the directors and consider the whole position.

The Chairman said, speaking for himself, he should be very glad to get turned out. He did not go on that board willingly or for any purpose of his own. As to the ship, they did not want to give them a ship, and if it was not that the Eastern Company was interested in this company they would not get a ship at the price they did.

Mr. Cochrane said he had intended no reflection upon the directors when he spoke of the employment of the Eastern Company's ship.

The Chairman continued that the Eastern Company did not make any money out of the Direct Spanish Company. They had an object in buying the shares of the company, and that object, if realised, would be the making of the company—as none other could be—that was to get the lines to Carthagena. No one else could do this, and they (the directors of the Eastern Company) could not do it except in relation to their other traffic. They had got Sir Robert Morier to exert himself, with his great power, and he was authorised by the English Government to assist them. There was no way of making money in this company except by increasing the traffic and developing it. There was a cable going from here to the shores of Spain, nothing more, and unless they got traffic on to it they could not make money. He could not be responsible for the contracts entered into by the old board. The cable was far too overladen with capital; it was not represented by that capital now and never had been. The contractors had got out of it, and there it was. He would not move one finger to remain on the board; if his services were not appreciated he was willing to go out.

Mr. Etlinger said, as one of the directors of the former board, he wished to state that the affairs of the company could not be cared for more than they were by his two colleagues. They knew more about cable matters than anyone else they could get, and if a committee were appointed they would not cause a single sixpence more to be earned.

The Chairman said if they took away from him the power to recommend the ship at the rate he did it would be a bad day for them.

Mr. Dyet said, after the explanation Sir James Anderson had given, he should be very sorry to see any change.

Mr. Beard: I should like to see you take the company over altogether.

The Chairman replied that they were not likely to do so at a price which the shareholders of this company would accept.

Mr. Blunt, the solicitor to the company, then read a portion of the opinion of Mr. Horace Davey, Q.C., M.P., respecting the matter upon which Mr. Cochrane made inquiries. Mr. Davey said: "I am of opinion that the directors cannot properly pay a dividend on any of the shares, including the preference shares, until they have taken one of two courses, *i.e.* (1), have put the original cable into a proper state of repair and working order, or made adequate provision for that purpose; or (2), if they determine to abandon the old cable, have taken the proper steps under the Companies' Acts, 1877, to write off the capital represented by that cable, or a proper amount of it, as lost capital unrepresented by available assets."

The Chairman remarked that he wanted to say a few more words upon this subject, which was one which had always been before the directors of cable companies. One shareholder had the power to enjoin them against paying dividends under the circumstances they were now in, or of enforcing personal liability upon them (the directors), and in the Anglo-American Telegraph Company, of which he (the chairman) was a director, one shareholder, holding only £15 worth of stock, had so enjoined them. They had at first thought they could defy this shareholder, but they were obliged to give in, and he might inform them that they would get no director to come there and take the personal liability involved in the payment of dividends. The opinion which the solicitor had just read was but one of many of a similar nature.

Mr. Blunt added that Mr. Horace Davey repeated in the latter part of his opinion that no valid difference could be made between the preference and the ordinary shares.

Mr. Cochrane said he had put the question because he had found from the discussions at the meetings, and from private conversations, that some shareholders had an idea that if extra capital were called up, the directors would be relieved of their difficulty. He had always held the opinion which he had now ascertained was the opinion of Counsel as to the proper course.

The Chairman said they had only £12,000 that they could call up, and he did not think they could call that up for any other purpose than that for which it was subscribed—the making of land lines in Spain.

The resolution was then put and unanimously agreed to.

Mr. Stocks proposed a vote of thanks to the chairman, which was seconded by Mr. Dyet, and carried unanimously, the meeting thereupon terminating.

Brazilian Submarine Telegraph Company, Limited.

THE twenty-fourth half-yearly general meeting of this company was held at the Cannon Street Hotel on Thursday, the 29th ult., when the Rt. Hon. Viscount Monck presided, and there were but few shareholders present.

Mr. Richard Collett, the secretary, having read the notice convening the meeting,

The Chairman said: It now becomes my duty to move the adoption of the report, and in so doing I beg leave to congratulate you and myself on having attained a round dozen of years of existence as a company. In moving the adoption of the report there is very little that I have to say to you; the report contains in itself almost all the information that I could give you if I were to stand here speaking for an hour's time. Nevertheless, there are one or two observations which I should like to make to you. You will observe by the report that a fault has developed itself in the Madeira-St. Vincent section of the cable; and you are informed at the same time that it does not interfere with the execution of the work by the cable. A diminution of insulation has also taken place in the Lisbon-Madeira section, both faults being in the old cables, and of the same character. I daresay many of you in your horse dealing experience have encountered a horse which a veterinary surgeon would not pronounce sound, but which, for all practical purposes was a very good and useful animal and might last many years' work. It is the same with these cables; the diminution of insulation does not in the slightest degree interfere with the operations of the cable, but is such that an engineer in making his reports is obliged to make known; I have myself known a cable to work for eight or nine years just as if the fault were not present; the only difference is that we are obliged to work with greater care and not to apply so strong a battery power. With that exception the property is in a perfectly satisfactory state. The next thing to notice is the income which we derive from the property, and I am sorry to say that that income is short by about £7,000 of the receipts for the last half-year. That is due, in most respects, to the depression of trade which prevails all over the world, and which affects us just as it does all other commercial undertakings. Also we are exposed to competition, on the West Coast of South America, of a line which has taken away a certain amount of our traffic; and we have had to encounter a rate of exchange against Brazil which diminishes the value of the Brazilian money sent home to us from that country. But we have also reduced the expenses, which are £2,077 less this half year than last; and notwithstanding the diminution of income, we are still able to pay you your six per cent. and carry over a respectable balance for the next half year. You will see by the report that we have had the misfortune to lose one of our directors during the past half year. Señor Santos Silva was our representative at Lisbon, and under the powers entrusted to us the directors have elected the Duke de Loulé, whose name is familiar to us, his father having formerly been a director, and of great service in originally starting the company at Lisbon. By an accidental circumstance he retires at this meeting, and you will have an opportunity of pronouncing upon him. There is a matter affecting cable property generally which I think will be interesting to you. You know, and other companies know by more disagreeable experience, that cables are constantly stopped in shallow water, sometimes from wilful injury done to them, and sometimes from accident. This subject has become the ground of a convention between the powers interested in cable property, and the result has been an agreement entered into between all those powers for the protection of property of this description. A Bill to give effect to this convention was introduced into Parliament last session, and when the draft was placed before the companies there were certain points which we thought would press heavily upon our companies, and which required amendment. A large deputation waited upon the Duke of Richmond, who was at that time President of the Board of Trade, and nothing could be kinder or more fair than the manner in which we were received. By the intervention of Lord Tweeddale, who is a member of the board of the Anglo-American Telegraph Company, and who took charge of the amendments in the House of Lords, the Bill was amended in the form we thought necessary, and ultimately it was passed, so that now, anyone wilfully injuring your property will be liable to punishment for the same. This is something, but it does not go as far as international legislation ought to go on this subject, because it would be quite possible to have a convention which would protect your property in time of war as well as in time of peace. Of course no one would imagine that belligerents would consent to cable operations going on through their waters during war, but the property might be protected while the traffic was suspended. Steps have already been taken in that direction, and we may look in the future for further protection for our shareholders even in time of war. The Chairman then moved the adoption of the report and the declaration of a dividend of 3s. per share, which, with previous distributions, would make a total dividend for the year of 6 per cent.

Sir James Anderson seconded the motion, and took the opportunity of remarking upon the great service to the company which had been rendered by Señor Santos Silva.

Mr. John Newton asked whether at the Berlin Conference anything had been promulgated which touched the interests of this company.

Sir James Anderson said Mr. Fuller, the managing director, more especially represented this company, but as nothing very material to the Brazilian Company resulted, it would perhaps be better if he replied to the question put. A great effort was made to get this company to reduce its rates, but it did not appear to be desired by their colleagues of the Western Brazilian Company or by the Brazilian Government, and the rates therefore remained as they were. The whole tendency of these conferences, however, was to reduce rates. He would not say that that was unfortunate, but there was a phase in it which the public might as well know. All the governments of the world, with only two exceptions, had a large deficit on the working of their telegraph administrations; and, notwithstanding that, Germany was determined to have them make larger deficits still, with the result, so far as European traffic was concerned, that there had been a reduction in the tariffs of 40 per cent., and he did not think, so far as he could see, that European Governments liked that. But in deference to the great energy, vigour and ability of the president of the conference they had to submit as they best could. There was this peculiarity shown at first at the convention: that a great many of the delegates considered that cables were luxuries; and, so far as the States they represented were concerned, they were luxuries, and of no use, apparently. After the discussions which took place, however, those gentlemen found that cables were of indispensable value for the external commerce of the world, which was growing every day; and when it came to be discussed the term *cables de luxe* was tabooed. Another expression, however, was then heard, and that was that certain cables were the normal way for telegrams, and it was generally agreed that those cables should be supported, and that their tariffs should not be taken from them in the tremendous, rough fashion first proposed. The majority of the States fell in with this view, so that they were not obliged to reduce to anything like the extent at first desired, which would have ruined some of the companies altogether. They had, in fact, managed to get the rates kept up to a fair amount, and if the traffic increased consequent upon the large reduction made in Europe, their loss would be little. It was pointed out that whilst the States could tax the community for any deficiency, directors of companies could not tax the shareholders or anyone else, and the shareholders would kick them out if they did not pay dividends. When this was put before the delegates he thought they saw the propriety of it; and so by getting a little here and a little there, the companies transacting business between Enropean States, the Direct Spanish, the German Union, and the Eastern Company with all its immense ramifications in the Mediterranean, were allowed to have a certain tariff by which they believed they would not be much injured. At first it seemed that the Eastern Company was going to lose £40,000 a year on the European traffic alone. The £40,000 came down to £12,000 on the face of it; and in two years' time he did not believe that company would be losing anything, assuming that the reduction increased the traffic. That was the benefit they derived by being at the Conference to urge their case to the gentlemen assembled there, who were mostly strangers, and not the old hands who used to be at Rome, St. Petersburg, Paris and London. In those days the principle recognised was that a telegraph system ought to pay; but that was not the feature now, he was sorry to say. The prominent idea in the minds of the European States, and especially of Germany, was that that was a secondary matter. There the telegraph system was fused with the Post Office, and they did not care what they lost in the one department because they could make it up in other ways; they believed that the indirect benefit which they derived from the increase of commerce was more to their advantage than the amount they lost on the telegraph administration. France would lose £60,000, and that was a loss which they recognised quite well that the companies could not afford to lose, and accordingly the French delegates supported the companies to get tariffs and to raise the tariffs at the terminals in Spain, France and Austria to a point at which the companies could live. His (Sir James Anderson's) opinion was that the Brazilian Company would be attacked in due time, and would have to come down. He, as his colleagues knew, was in favour of low tariffs, for he thought high tariffs tended to throttle traffic. But the time when that would be necessary was not yet, and for the present they had nothing to fear.

Mr. Newman said what he had just heard confirmed him in the views he had always expressed, that the reserve fund should be increased from year to year as much as possible, and he should be very glad to see the interest reduced from 6 per cent. to 5 per cent. for that purpose, although he knew he would be in a minority if that were put to the shareholders.

The retiring directors, Viscount Monck and the Duke de Loulé, and the auditors, Messrs. Henry Dever and John Gane, were unanimously re-appointed; a vote of thanks to the chairman then terminating the meeting.

The Eastern Extension, Australasia and China Telegraph Company, Limited.

The report of the directors for the half-year ended 30th June, states that the gross receipts, inclusive of Government subsidies, have amounted during that period to £259,476 9s., against £237,672 11s. 5d. for the corresponding period of 1884, showing an increase of £21,803 17s. 7d.

The working and other expenses, including £23,406 15s. 6d. for cost of repairs and renewals of cables and expenses of ships, absorb £74,418 6s. 9d. against £66,658 18s. 9d. for the corresponding half-year of 1884, leaving a balance of £185,058 2s. 3d. From this is deducted £3,104 15s. 4d. for income tax, and £41,595 for interest on debentures and contributions to sinking funds, leaving £140,358 6s. 11d. as the net profit for the half-year, against £127,415 15s. 8d. for the corresponding period of 1884. Against this the directors have charged a further sum of £20,000 on account of the partial renewal of the Singapore-Saigon and Penang-Rangoon cables. The cost of the operations will be shown in the accounts for the current half-year, the whole of the cable not having been picked up before the 30th June.

One quarterly interim dividend of 1¼ per cent., amounting to £31,250, has been paid during the half-year, and another of like amount, together with a bonus of 2s. per share, was distributed on the 15th ultimo, making a total payment of 3¼ per cent. for the half-year, leaving £32,858 6s. 11d. to be carried forward.

In accordance with the provisions of the trust deed, dated 10th May, 1879, 239 Five per Cent. Australian Government subsidy debentures were drawn on the 29th April last for payment at par on the 1st July.

A new cable steamer, *Recorder*, has been built for the company by Messrs. R. Napier & Sons, to replace the ss. *Magneta*. She is now fitting out in the Thames, and will shortly be despatched to Singapore.

No serious interruptions have occurred during the half-year, although the company's ships have been employed on various repairs. They have also been employed on charter to the Telegraph Construction and Maintenance Company for a considerable period. At the same time, 322 knots of cable, taken principally from the company's stock at Singapore, were sold to that company. The latter transaction will appear in the current half-year's accounts. All the company's cables are now in good working order.

At the International Telegraph Conference recently held at Berlin, several important questions were discussed affecting the telegraphing public, but the principal changes made in the existing Convention were in the direction of cheapening the European tariffs. The new Convention will come into force on the 1st July, 1886.

The question of reduction of rates has been under the consideration of your board for some considerable time, and at the Conference it was agreed to make certain reductions to Australia and China on condition that the Indian and South Australian Governments reduced their transit rates. The South Australian Government have agreed to bear their share of the reduction, and negotiations with the same object are proceeding with the Indian Government.

The land line between Port Darwin and Adelaide, belonging to the South Australian Government, has as usual worked well during the half-year under review.

The Jarman Electrical Company, Limited.—At an extraordinary general meeting of the above-named company, held at No. 6, Great Winchester-street Buildings, on the 5th ult., the following special resolutions were duly passed:—1. That the company be wound up voluntarily, under the provisions in that behalf of the Companies Acts, 1862-7; 2. That Mr. W. Smith, of 6, Great Winchester-street, E.C., be appointed liquidator for the purpose of winding up the affairs of the company; 3. That the liquidator be authorised, under the 161st section of the Companies Act, 1862, to carry out the agreement of 31st July, 1885, between the said Jarman Electrical Company, Limited, of the first part, Chainsonovitz Prosper Elieson of the second part, and Edward Spendlove, as trustee for and on behalf of the Electric Locomotive and Power Company (since registered) of the third part, and any confirmatory agreement for the sale to the said Electrical Locomotive and Power Company of the business, property, and effects of the said Jarman Electrical Company. These resolutions were confirmed on the 22nd ult.

The Anglo-Continental Telephone Company, Limited.—A general meeting of the members of this company will be held at the offices of Messrs. Fox and Greig, No. 22, Austin Friars, London, E.C., on Thursday, the 26th prox., at 3 o'clock, for the purpose of having an account laid before them, showing the manner in which the voluntary winding up has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator; and also of determining the manner in which the books, accounts, and documents of the company and of the liquidator shall be disposed of.

United Telephone Company, Limited.—At the board meeting of the company, on Tuesday, the directors being satisfied that the position of the company justifies them in making a somewhat larger payment on account of the earnings of the current financial year than heretofore, determined to pay 4s. on each fully-paid share (part paid shares receiving in proportion) by way of interim dividend.

The Electric Sun Lamp and Power Company, Limited.—The creditors of the above-named company are required, on or before the 4th day of December, 1885, to communicate with Messrs. William Perkins, Matthew Inglett Fortescue Brickdale, and Henry de Grelle, the liquidators of the company, at 5, Bombay Street, Bermondsey.

London Platino-Brazilian Telegraph Company, Limited.—An interim dividend for the half-year ended Sept. 30 of 1s. per share has been declared, payable on and after the 17th inst.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of October was 2,694, estimated to produce £2,100, against 2,589 messages, producing £2,230 in the corresponding month of last year. The receipts for the month of July, estimated at £2,500, realised £2,517.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st October, are £1,931, as compared with £2,512 in the corresponding period of 1884. The July receipts, estimated at £5,089, realised £5,157.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 30th were £2,558, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for October, 1885, amounted to £43,986, and to £41,359 in the corresponding period of 1884.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October were £1,748, against £1,816 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The receipts for October amounted to £56,994 and to £53,865 in the corresponding period of 1884.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended October 30th, amounted to £3,314.

NEW PATENTS—1885.

12982. "Constant-speed electric motors." W. M. Mordey, C. Watson. Dated October 28.

12984. "Method of and apparatus for working metals and metalloids by the direct application of electric currents." N. de Benardos, S. Olzewski. Dated October 28.

13011. "Electric arc lamps." W. E. Heys. (Communicated by O. P. Loomis and H. W. Cooley.) Dated October 29. (*Complete.*)

13015. "Means for suspending electric lamps." T. B. Wilson. Dated October 29.

13036. "Carbons for incandescent lamps." A. Bernstein. Dated October 29.

13038. "Transmitting an intermittent current for illuminating lighthouses, &c., or for signalling by means of electric light flashes." H. E. Johnson. Dated October 29.

13109. "Arrangements or systems of underground electric conductors and apparatus for use in connection therewith." W. R. Lake. (Communicated by D. H. Dorsett.) Dated October 30. (*Complete.*)

13140. "Making waterproof cloth, felt, board and paper for insulating purposes." J. E. A. Pierret. Dated October 31.

13201. "Incandescent electric lamps." L. J. Crossley, J. J. Hicks. Dated November 2.

13207. "Manufacture of metal wire for electrical transmission and other purposes." E. Martin. Dated November 2.

13232. "Fire alarm apparatus." J. C. Wilson, M. Martin. Dated November 3. (*Complete.*)

13234. "Automatic self-adjusting electric indicators." P. Jolin, T. Ballard. Dated November 3.

13246. "Electric lamps used for photographic purposes." E. G. Craven. Dated November 3.

13266. "Dynamo-electric machine." L. A. Groth. (Communicated by R. Vogler.) Dated November 3.

13269. "Telephonic transmitters." G. L. Anders. Dated November 3.

13290. "Dynamo-electric machines." P. W. Willans. Dated November 3.

13300. "Invalids' electric call bell." T. E. Usher. Dated November 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

12153. "Improved electrical torsion pendulum." A. J. Boult. (Communicated from abroad by G. Rabe, of Germany.) Dated September 8. 6d. Relates to a torsion pendulum driven by electricity by receiving an impulse from an electro-magnet, the pendulum automatically closing at the proper time, an electrical circuit exciting the magnet.

12219. "Portable dynamic instruments for the conversion of manual force into electric force and the utilisation thereof." J. S. Williams. Dated September 9. 6d. Relates to portable electric apparatus having devices or means integral with or forming part thereof for the conversion of manual force into electric force, and for the conduction of such force through an electric circuit thereof, such circuit being arranged for interposing resistance to the passage of the current, and thereby to develop heat or an electric arc of sufficient intensity in that portion of the circuit which is adapted to provide for causing the transformation of the electric force into heat, so as to ignite inflamable gas, or for the transmission of the current through an electric circuit connected therewith, in which a resistance is placed or arranged for the transformation or utilisation of such force for the development of signals audible or visual as for telegraphic or telephonic purposes, or for the firing of explosives or mines for industrial, military, or naval purposes.

12524. "Improvements in electric gate blocking apparatus." E. E. Evans. Dated September 18. 6d. The inventor places an electro magnet in the gate post or other convenient position, which controls a catch. This catch, in its normal position, is kept clear of the bolt or finger on the gate, either by a spring or a balance weight or other equivalent device, but on the electro-magnet being put into action, this catch is drawn either up or down (by the action of the magnet) over the bolt or finger on the gate, so that it cannot be opened till the electric current is taken off. In this arrangement it is assumed that the gates are hung so that they automatically close themselves. The necessary electric current is furnished by a battery placed in the signalman's house.

12675. "Improvements in manufacture of carbons for incandescent electric lamps." M. Evans and F. Wynne. Dated September 22. 4d. The inventors take a solution of cellulose, and this, in plastic or semi-liquid or liquid state, they project or allow to flow, and regulate its flow through an orifice or die of any suitable shape so as to form, when suitably treated, strings, or bands or tubes of uniform section and of any required length. On issuing from the orifice they project the stream of cellulose solution into a liquid or mixture of liquids, or a solution or a gas such as has the property of fixing, setting, or coagulating the issuing stream, thereby enabling it to retain the form given to it. One material which they find it convenient to employ for production of the cellulose solution is obtained by treating cotton or other suitable vegetable fibre, thread, or fabric, with a solution of zinc chloride, and this solution they fill into a vessel from which after treatment in vacuo they afterwards express it through the desired orifice into the fixing fluid by means of a mercury pressure from below, or other means. The fixing fluid they may form of sulphuric ether or other suitable liquid or gas, and they may add to it hydrochloric acid or any other suitable liquid for the purpose of purifying the fixed or coagulated thread. The latter is afterwards carbonised in the usual manner.

13133. "Improvements in and relating to the manufacture of incandescence electric lamps." H. Watt. (Communicated from abroad by E. Weston, of America.) Dated October 3. 6d. The inventor takes a suitable quantity of gun-cotton and dissolves it in a solution of camphor, or otherwise reduces it to the condition of celluloid; it then has the appearance of a cake of light-coloured glue. This cake is then split by means of a suitable tool into thin sheets, which are treated with sulphide of ammonium, so as to produce a pure non-structural substance. This substance is rolled into very thin sheets, and stamped or formed by means of dies into the wavy shape of the ordinary Weston filament, flat end pieces being provided having apertures for attachment to the wire terminals of the lamp. A large number of the pieces thus formed are placed between sheets of paper and packed with powdered plumbago in nickel boxes, which are heated in a small furnace for an hour or two, and then slowly cooled.

13324. "Improvements in railway electrical signalling apparatus." J. W. Fletcher. Dated October 8. 6d. Consists of an improvement in the arrangement and apparatus at present employed in electrical signalling specially applicable to railway work, whereby only a single wire is used between the signal and the signal box for indicating the position of the signal, and also the state of the signal light at night. For this purpose the inventor employs an improved form of contact-maker, consisting of a pole changer or other modification thereof in connection with the signal arm, together with an improved system of contacts for indicating in the signal cabin the state of the light at night. The contact maker consists of four springs or their equivalent, actuated by a cam or eccentric, together with four springs, two of them being to the earth, and the remaining two to the poles of a battery. The semaphore, representing the signal arm, is worked by a needle coil, and an indicator showing "light in" or "light out" is worked by an electro-magnet.

14109. "A safety apparatus for use in the high tension system of electric lighting." A. Wright. Dated October 25. 4d. Consists of an electro-magnet which actuates a switch when a lamp breaks.

14496. "Electrical railway signalling." J. Enright. Dated November 3. 6d. There are fixed along the permanent way, in any convenient place, coils of insulated wire with iron cores. These are joined up in series with a battery by means of a line wire, which is also insulated and continued to the station or signal box. On the train is fixed a coil or permanent magnet, so that as it passes along the coil or magnet shall come into close proximity with a line coil. This causes an induced current to flow in the coil on the permanent way, which opens to any convenient indicator at the station. Thus the train signals itself at various points along the line.

14508. "Improvements in secondary batteries." A. H. Reed. (Communicated from abroad by E. Commelin, G. Bailhache, A. L. de Virloy, and L. de Bousignac, all of Paris.) Dated November 3. 4d. The new or improved apparatus consists as follows:—1st. Of a vessel of rectangular or other suitable form in wood, cork or other material, lined with gutta-percha or other material proof against alkalis; the said vessel being divided into three liquid-proof compartments. 2nd. Of three very thin carbon plates, each separately covered with a layer of a mixture consisting of pulverised metallurgic or gas coke or retort coal, or plumbagine, and hydrate of oxide of copper, or anhydrous oxide of copper, or hydrate of oxide of nickel, or anhydrous oxide of nickel, or other metallic oxides which are insoluble in a solution of potash or of soda; the said layer being protected by a hempen cloth, this constituting the positive pole, and each carbon plate being placed in the centre of each compartment. 3rd. Of six copper thin plates wrapped with copper wire gauze and folded in the form of a very shallow box, or of six perforated copper plates constituting the negative pole, two of these plates or boxes being placed in each compartment, one on each side of the carbon. 4th. Of a concentrated solution of zincate of potash or soda containing a sulphate of soda or potash, with an excess of potash or soda.

14652. "Improvements in telephonic apparatus." J. Stephen. Dated November 6. 6d. A vibratile coil is pivoted within the stem or cylindrical portion of the instrument, in such relation to a magnetic field that when used as a transmitter, the coil on being deflected has currents of electricity induced therein, and when used as a receiver, currents passing round the coil tend to deflect the said coil from its normal position.

14723. "Improvements in dynamo-electric machines." The Hon. C. A. Parsons. Dated November 7. 6d. Relates to electric generators designed to be driven with safety at a high rate of speed, several or many times as fast as such machines are ordinarily driven, and wherein the speed shall be capable of regulation so that the generator may give either a constant current or a constant electromotive force, as may be desired.

14916. "Improvements in dynamo-electric machines." S. Pitt. (Communicated from abroad by C. de Nottbeck, of St Petersburgh.) Dated November 12. 6d. Relates to the construction of the collector.

14981. "Improvements in the construction and application of carbon or carbonaceous electrodes for primary and secondary elements." R. H. Radford. (Communicated from abroad by H. F. B. Schaefer, of Berlin.) Dated November 13. 4d. A hose (*id est*, a flexible tubular case or envelope) is produced by the ordinary mechanical appliances of a hose loom, knitting, crotchetting, or lace machine. This hose is filled during its production with small particles of carbon or carbonaceous material, which are pressed in firmly, so that the production of the hose progresses in the same ratio as the filling thereof, which is also accomplished by mechanical means.

CORRESPONDENCE.

The Dangers of Secondary Generators.

I was not aware when sending for publication in your columns a note on the subject, that the remedy proposed by me for obviating any danger from electrostatic charge had already been the subject of a patent by Professor E. Thomson in the United States, and I am glad to learn that he has another method for avoiding, in addition, danger from leakage through from the primary, and also that he endorses the opinion that the method of keeping one pole of the secondary to earth is as effectual as it is a simple device for preventing dangerous discharges from electrostatic accumulation. Having, however, given independent publication to the suggestion in your columns last September, I trust that, in the United Kingdom at least, users of secondary generators will be at liberty to unite one pole of their secondary generators to the gas-pipes by means of a piece of copper wire, without rendering themselves liable to an injunction for infringement of a patent.

J. A. Fleming.

Edison and Swan United Electric Light Co.,
57, Holborn Viaduct.
November 2nd, 1885.

We observe in your last issue that Mr. Elihu Thomson claims the suggestion made by Dr. Fleming in your number for the 26th of September, of *earthing the secondary coils* (in a system of distributing electric energy with secondary generators) in order to obviate the source of danger pointed out by Dr. Hopkinson. As our absence from London prevented our seeing Dr. Hopkinson's article until a day or two before Dr. Fleming's letter appeared, we did not write at the time, but we now desire to mention that the importance of earthing the secondary coils has been regularly pointed out by us in our lectures on methods of distributing electric energy given to students at the Technical College, Finsbury, and at the Central Institution, South Kensington, since we originally made some experiments on Messrs. Gaulard and Gibbs' secondary generators at the Aquarium Electrical Exhibition in 1883. The idea is therefore quite public property.

W. E. Ayrton.
John Perry.

November 3rd, 1885.

Electric Lighting in the United States.

We beg to call your attention to an article in your number of October 10th, page 309, "Electric Lighting in the United States," in which it is stated, "In the Brunswick Hotel are to be found the remains of what was once an incandescent light installation," &c. The facts in the case are these: this hotel has been lighted from our Stanhope-street Station for some two years past, except certain months in the summer. Your correspondent must have seen the lamps then; if he calls there now he will see them burning. There were no dead remains at any time.

John H. Alley.

The New England Weston Electric Light Co.
Boston, *October 19th*, 1885.

Secondary Generators or Transformers.

In our letter to you of the 17th of September, replying to the pretensions of Messrs. Zipernowski, Déri and Blathy, based upon the comparison made by Professor Ferraris, between our secondary generators and their transformers, we though it incumbent upon us to call the attention of Professor Ferraris to the fact that if he had considered our apparatus as working under the best practical conditions, which he pointed out in his report to the Academie des Sciences de Turin, that is with a resistance of 26 ohms, when the primary and secondary circuits are equal, the current in the primary being 12 ampères, he would have been forced to admit that the secondary generators had at least the advantage over the transformers of Zipernowski, Déri and Blathy, of an interior resistance smaller by half for producing practically the same external work with the same weight of copper.

Before affirming in their letter of the 10th of October that the statement made by us was not correct, and that our apparatus produced 2 H.P., while theirs gave 4 H.P., these gentlemen might have waited to know what Professor Ferraris had to say. Even if they had consulted the report to the Academie des Sciences de Turin, which all the scientific papers have published, they might have found in the table of exterior practical returns of apparatus working with a primary current of 12 ampères, with resistances varying from ·2 to 40 ohms, an effective return of 95 per cent., and at the end of the report, they might also have seen the sentence we have already quoted, which runs thus:—"We think it may be useful to remark that when the core of the secondary generator is entirely of iron, the best method of using this apparatus practically is to have a resistance of 26 ohms in the exterior circuit."

It is very clear that the secondary generators, which we had represented would give a useful exterior work of 2 H.P., with a resistance of 10 ohms, would produce with a resistance of 26 ohms as work — $12^2 \times 26 =$ 3744 watts—5 per cent $= \frac{12^2 \times 26 \times 95}{100} = 3556$ watts; by coupling the secondary circuit in two equal and parallel parts, the quantity of the current is doubled, and in order that the work may remain the same, it is necessary that the resistance of the exterior circuit should be divided by 4; that is to say, we should have $W = 24^2 \times \frac{26}{4} = 24^2 \times 6{\cdot}5 = 3744$.

We hope we have now shown beyond question that the best method of employing a secondary generator for feeding a resistance of 6 ohms—the same used by Professor Ferraris when experimenting with the Zipernowski apparatus—is to couple the secondary circuit of one only of our apparatus in two equal and parallel parts.

On the other hand, these gentlemen think to avoid the reproach of having deliberately copied us by pretending that the only resemblance existing between our system and theirs is that both utilise the phenomena of induction produced by alternating currents. We have never denied that they have the right to employ induction and to use alternating machines, even if they be hyper-compound, which latter, we may remark, do not seem to us to compensate for the variations in speed; but that which we shall not allow them to do without our authority is to use transformers constructed in accordance with the rules we have been the first to lay down, which rules alone enable the obtaining of the effective return, the bare possibility of which we have had so much trouble in getting admitted. These dispositions have been solemnly recognised to be our property by the International Jury of Turin, and it is astonishing that Messrs. Zipernowski, Déri and Blathy can deny that there is any resemblance between our apparatus and theirs, when the fact is that they only commenced their work after having received from ourselves explanations of the details of working and construction, and that the report of Prof. Ferraris, which they have so extensively tried to make capital out of, concludes with the following phrase:—"Consequently in the annular transformer, as well as in that made of discs, the primary and secondary helices are placed relatively to the iron in identical conditions."

We willingly recognise that it is in the public interest that all who desire should assist in seeking improvements in the construction of the secondary generators, and in the mode of utilising them; but it is only just that before employing as a point of departure results obtained by us, our permission should at least be asked. When researches of such vital importance are undertaken they require, to ensure success, not only long sustained hard work, but also, before results can be practically proved, very considerable outlay; and it would be unjust that, under the pretext of improvements, those who first seeing the importance of the problem to be solved have embarked their future in it, should not, the end being attained, reap the legitimate reward of their sacrifices. If this were so all progress would be quickly stopped, for it would be impossible to find assistance from capital even for the most wonderful invention. We have thought it our duty to warn your readers that all who aid in industrially applying this infringement of our invention will expose themselves to legal action.

We thank you for enabling us to give this last notice through your columns.

L. Gaulard.
J. Dixon Gibbs.

London, *November 2nd*, 1885.

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